Programación Evolutiva

Práctica 2

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# Introducción:

Para esta práctica, hemos introducido los siguientes cambios opcionales, que no estaban presentes en la primeras:

- **Escalado lineal** para las selecciones en las que este tiene sentido: Nos hemos encontrado con el problema de que algoritmos de selección que dependen del fitness como la ruleta estaban introduciendo demasiada presión selectiva y la evolución se acababa estancando. Es para reducir dicha presión para lo que introducimos el escalado lineal en la ruleta, selección universal estocástica.

**- Selección por ranking**: La selección con ranking la hemos implementado de forma que la diferencia entre la posibilidad de elegir al mejor y al peor no sea muy grande. La posibilidad de elegirlos es lineal entre todos, y se escogen de manera similar a la ruleta.

**- Gráfico de presión selectiva**: Este muestra un valor entre dos y uno cuanto de cerca está la media de los mínimos y máximos. Un valor cercano a uno significa que hay poca diversidad y la media se acerca mucho al máximo, mientras que un valor cercano a dos significa que hay demasiada diversidad, y no se está priorizando la evolución de los mejores individuos. Nos proporciona información muy útil para elegir la mejor combinación de parámetros.

**- Consola en la GUI:** Esta nos permite ver más información en la interfaz gráfica, como la población final. Cualquier cosa que el programa escriba en salida estándar será redirigida aquí, pudiendo utilizarlo también para debuguear.

**- Barra de progreso:** Con el tiempo que empiezan a tardar los algoritmos con individuos muy grandes o gran número de generaciones, necesitamos una indicación que nos asegure que se está realizando la evolución.

Como operadores inventados u opcionales hemos creado los siguientes:

**Cruces:**

- **Corners:** Intercambia los valores a cada extremo del individuo.

**- OX-OP**

**Mutaciones:**

**- Intercambio múltiple:** Como hacer un solo intercambio varía muy poco el individuo cuando este es muy grande, el intercambio múltiple repite un número aleatorio de veces el intercambio.

**- Desplazamiento:** Repetición de un número aleatorio de veces de la inserción. La inserción se puede hacer hacia cualquier sentido.

**- Corte:** Como en una baraja de cartas, se corta por un punto y se intercambian los dos segmentos generados.

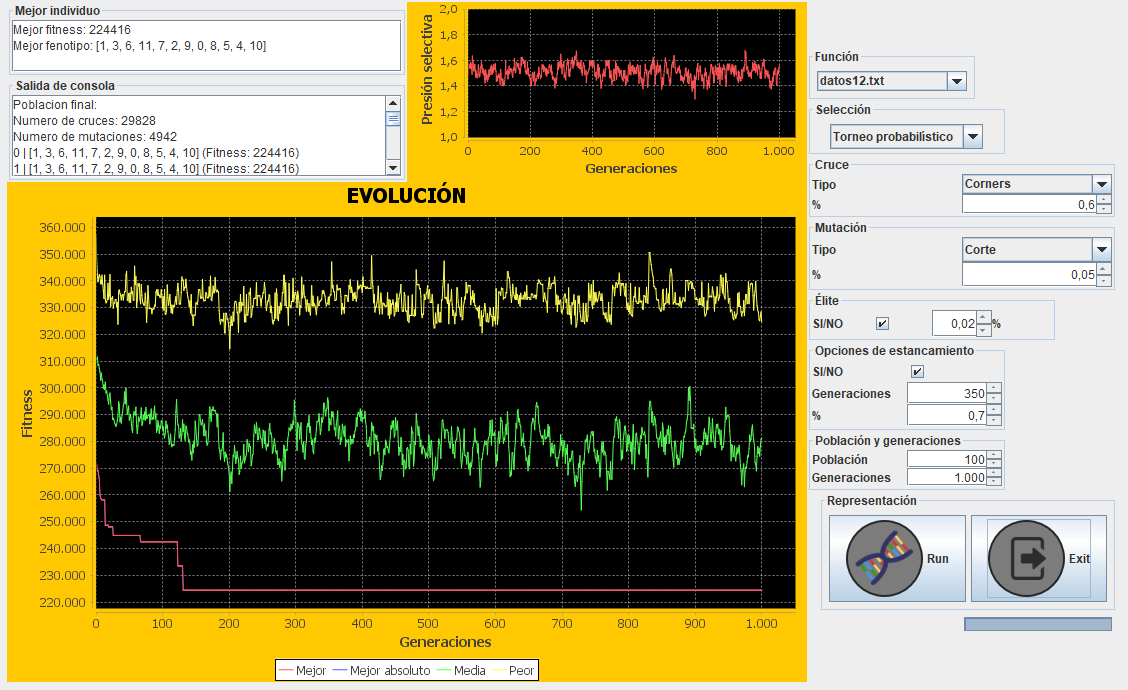
**- Heurística/Desplazamiento** **y Heurística/Inserción:** La mutación heurística genera muchísima presión selectiva, al elegir siempre al mejor individuo de los generados. Para remediarlo, estas dos mutaciones hacen el desplazamiento o inserción respectivamente un 70% de las veces, y mutan mediante heurística el 30% restante. Así obtenemos la aleatoriedad de las mutación con la ventaja de obtener el mejor con la mutación heurística.

Con los parámetros que hemos elegido queremos mostrar varias combinaciones con las que se pueden obtener resultados buenos, variando la selección, tipo de cruce y tipo de mutación. También se ha priorizado el tiempo de ejecución, que se empieza a hacer largo con individuos grandes y muchas generaciones. Por esto hemos limitado el número de generaciones a 2000 y el tamaño de la población a 100. Hemos considerado que estos valores ofrecen un tiempo de espera razonable para el usuario, obteniendo buenos resultados de igual manera.

Con la imagen que se encuentra en la ejecución representativa queremos mostrar, además de la gráfica de evolución pedida, los parámetros elegidos para todas las ejecuciones de un mismo problema a la derecha, y la gráfica de presión selectiva en la que intentamos mantener valores de 1,5. Hemos decidido escoger como ejecución representativa el mejor resultado obtenido de las 20 ejecuciones.

# Problema 1: datos12.dat

## Ejecución representativa:



**Individuo solución:** [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10]

**Aptitud máxima:** 224416

**Aptitud media:** 281162.48

**Aptitud mínima:** 324672

**Numero de cruces:** 29828

**Numero de mutaciones:** 4942

**Población final:**

0 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] (Fitness: 224416)

1 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] (Fitness: 224416)

2 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] (Fitness: 224416)

3 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] (Fitness: 224416)

4 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] (Fitness: 224416)

5 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] (Fitness: 224416)

6 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] (Fitness: 224416)

7 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 4, 5, 10] (Fitness: 242190)

8 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 4, 5, 10] (Fitness: 242190)

9 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 5, 3, 10] (Fitness: 244346)

10 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 5, 3, 10] (Fitness: 244346)

11 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 5, 3, 10] (Fitness: 244346)

12 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 5, 3, 10] (Fitness: 244346)

13 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 5, 3, 10] (Fitness: 244346)

14 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 5, 3, 10] (Fitness: 244346)

15 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 5, 3, 10] (Fitness: 244346)

16 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 5, 3, 10] (Fitness: 244346)

17 | [1, 3, 6, 11, 9, 2, 7, 0, 8, 5, 4, 10] (Fitness: 248766)

18 | [1, 3, 6, 11, 7, 2, 5, 0, 8, 9, 4, 10] (Fitness: 249280)

19 | [1, 3, 6, 11, 0, 2, 9, 7, 8, 5, 4, 10] (Fitness: 250764)

20 | [1, 5, 6, 11, 7, 2, 9, 0, 8, 4, 3, 10] (Fitness: 252696)

21 | [1, 5, 6, 11, 7, 2, 9, 0, 8, 4, 3, 10] (Fitness: 252696)

22 | [1, 4, 6, 11, 9, 2, 7, 0, 8, 5, 3, 10] (Fitness: 252876)

23 | [1, 4, 6, 11, 9, 2, 7, 0, 8, 5, 3, 10] (Fitness: 252876)

24 | [1, 4, 6, 11, 9, 2, 7, 0, 8, 5, 3, 10] (Fitness: 252876)

25 | [5, 3, 6, 11, 7, 2, 9, 0, 8, 1, 4, 10] (Fitness: 253712)

26 | [1, 3, 0, 11, 7, 2, 9, 6, 8, 5, 4, 10] (Fitness: 256010)

27 | [1, 3, 6, 11, 7, 8, 9, 0, 2, 5, 4, 10] (Fitness: 257150)

28 | [5, 3, 6, 11, 8, 2, 9, 0, 7, 1, 4, 10] (Fitness: 258380)

29 | [1, 3, 6, 11, 7, 4, 9, 0, 8, 5, 2, 10] (Fitness: 259248)

30 | [1, 3, 6, 11, 7, 4, 9, 0, 8, 5, 2, 10] (Fitness: 259248)

31 | [1, 3, 6, 11, 7, 2, 4, 0, 8, 5, 9, 10] (Fitness: 259580)

32 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 3, 5, 10] (Fitness: 259728)

33 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 3, 5, 10] (Fitness: 259728)

34 | [1, 4, 6, 11, 7, 2, 9, 0, 8, 3, 5, 10] (Fitness: 259728)

35 | [4, 1, 6, 11, 7, 3, 9, 0, 8, 5, 2, 10] (Fitness: 264536)

36 | [5, 3, 6, 11, 7, 2, 4, 0, 8, 1, 9, 10] (Fitness: 265524)

37 | [1, 2, 6, 11, 7, 3, 9, 0, 8, 5, 4, 10] (Fitness: 266706)

38 | [1, 2, 6, 11, 7, 3, 9, 0, 8, 5, 4, 10] (Fitness: 266706)

39 | [1, 6, 3, 11, 7, 5, 9, 0, 8, 4, 2, 10] (Fitness: 268318)

40 | [1, 6, 3, 11, 7, 5, 9, 0, 8, 4, 2, 10] (Fitness: 268318)

41 | [1, 4, 6, 11, 7, 5, 9, 0, 8, 3, 2, 10] (Fitness: 271902)

42 | [2, 1, 6, 11, 7, 3, 9, 0, 8, 5, 4, 10] (Fitness: 274418)

43 | [5, 9, 6, 11, 7, 2, 4, 0, 8, 1, 3, 10] (Fitness: 274516)

44 | [1, 2, 6, 11, 7, 5, 9, 0, 8, 4, 3, 10] (Fitness: 276698)

45 | [1, 4, 9, 11, 7, 10, 6, 0, 8, 5, 3, 2] (Fitness: 277186)

46 | [1, 4, 9, 11, 7, 10, 6, 0, 8, 5, 3, 2] (Fitness: 277186)

47 | [5, 3, 6, 11, 7, 2, 9, 1, 8, 0, 4, 10] (Fitness: 277512)

48 | [1, 2, 6, 11, 7, 4, 9, 0, 8, 5, 3, 10] (Fitness: 279626)

49 | [1, 5, 0, 11, 7, 2, 9, 6, 8, 3, 4, 10] (Fitness: 282002)

50 | [5, 3, 0, 11, 8, 2, 9, 6, 7, 1, 4, 10] (Fitness: 282828)

51 | [5, 1, 6, 11, 7, 2, 4, 0, 8, 9, 3, 10] (Fitness: 283072)

52 | [6, 3, 9, 0, 8, 2, 5, 11, 4, 1, 7, 10] (Fitness: 283774)

53 | [3, 5, 6, 11, 7, 2, 4, 0, 8, 1, 9, 10] (Fitness: 286538)

54 | [5, 9, 6, 3, 7, 2, 4, 0, 8, 1, 11, 10] (Fitness: 287992)

55 | [2, 9, 0, 8, 5, 11, 10, 1, 4, 6, 3, 7] (Fitness: 288214)

56 | [1, 0, 3, 11, 7, 2, 9, 6, 8, 5, 4, 10] (Fitness: 289444)

57 | [8, 4, 6, 11, 7, 2, 9, 3, 5, 0, 10, 1] (Fitness: 289520)

58 | [1, 3, 0, 11, 7, 10, 6, 9, 8, 5, 4, 2] (Fitness: 289836)

59 | [1, 3, 0, 11, 7, 4, 9, 6, 8, 5, 2, 10] (Fitness: 291862)

60 | [5, 9, 0, 11, 7, 2, 4, 6, 8, 1, 3, 10] (Fitness: 296372)

61 | [10, 6, 3, 1, 7, 11, 2, 4, 0, 5, 8, 9] (Fitness: 296684)

62 | [1, 4, 0, 11, 7, 3, 9, 6, 8, 5, 2, 10] (Fitness: 296968)

63 | [2, 11, 0, 8, 5, 9, 10, 1, 4, 6, 3, 7] (Fitness: 297252)

64 | [10, 9, 11, 1, 5, 4, 6, 3, 7, 2, 8, 0] (Fitness: 299456)

65 | [6, 10, 3, 1, 4, 11, 2, 7, 0, 5, 8, 9] (Fitness: 299476)

66 | [10, 6, 4, 1, 7, 11, 2, 3, 0, 5, 8, 9] (Fitness: 300222)

67 | [9, 0, 8, 5, 2, 10, 1, 4, 6, 11, 7, 3] (Fitness: 300672)

68 | [6, 2, 8, 1, 9, 0, 10, 5, 3, 7, 11, 4] (Fitness: 303772)

69 | [7, 5, 3, 8, 4, 11, 1, 10, 0, 6, 2, 9] (Fitness: 305588)

70 | [1, 5, 3, 10, 8, 9, 6, 11, 7, 2, 4, 0] (Fitness: 307652)

71 | [2, 11, 0, 8, 5, 3, 10, 1, 4, 6, 9, 7] (Fitness: 312304)

72 | [2, 11, 0, 8, 5, 3, 10, 1, 4, 6, 9, 7] (Fitness: 312304)

73 | [10, 1, 5, 6, 11, 7, 2, 9, 0, 8, 4, 3] (Fitness: 312326)

74 | [6, 11, 5, 8, 4, 2, 1, 10, 0, 7, 3, 9] (Fitness: 312588)

75 | [0, 11, 5, 8, 4, 2, 1, 10, 6, 7, 3, 9] (Fitness: 312894)

76 | [0, 11, 8, 4, 10, 5, 2, 7, 3, 9, 6, 1] (Fitness: 313792)

77 | [0, 11, 8, 4, 10, 5, 2, 7, 3, 9, 6, 1] (Fitness: 313792)

78 | [6, 11, 8, 1, 9, 0, 10, 5, 3, 7, 2, 4] (Fitness: 314872)

79 | [7, 2, 3, 1, 11, 8, 5, 9, 0, 10, 6, 4] (Fitness: 315392)

80 | [8, 4, 2, 10, 11, 9, 6, 1, 7, 3, 5, 0] (Fitness: 315492)

81 | [7, 11, 0, 8, 5, 3, 10, 1, 4, 6, 9, 2] (Fitness: 316832)

82 | [1, 9, 3, 10, 8, 4, 6, 11, 7, 2, 5, 0] (Fitness: 318328)

83 | [7, 5, 3, 8, 4, 2, 1, 10, 0, 6, 11, 9] (Fitness: 319484)

84 | [7, 5, 3, 8, 4, 2, 1, 10, 0, 6, 11, 9] (Fitness: 319484)

85 | [7, 5, 3, 8, 4, 2, 1, 10, 0, 6, 11, 9] (Fitness: 319484)

86 | [6, 3, 5, 8, 4, 2, 1, 10, 0, 7, 11, 9] (Fitness: 319554)

87 | [8, 10, 3, 1, 4, 11, 2, 7, 0, 5, 6, 9] (Fitness: 319892)

88 | [0, 11, 8, 4, 10, 5, 2, 7, 3, 6, 9, 1] (Fitness: 320358)

89 | [1, 5, 3, 10, 8, 4, 6, 11, 7, 2, 9, 0] (Fitness: 321084)

90 | [8, 5, 4, 10, 1, 2, 0, 11, 7, 3, 9, 6] (Fitness: 321380)

91 | [1, 0, 5, 8, 4, 2, 3, 10, 11, 7, 6, 9] (Fitness: 321576)

92 | [10, 6, 4, 1, 7, 5, 2, 3, 0, 8, 11, 9] (Fitness: 322192)

93 | [9, 11, 7, 10, 6, 4, 8, 5, 0, 2, 1, 3] (Fitness: 323104)

94 | [0, 2, 3, 1, 11, 8, 5, 9, 7, 10, 6, 4] (Fitness: 323196)

95 | [2, 9, 0, 8, 5, 3, 10, 1, 4, 6, 11, 7] (Fitness: 323802)

96 | [2, 9, 0, 8, 5, 3, 10, 1, 4, 6, 11, 7] (Fitness: 323802)

97 | [10, 9, 11, 1, 8, 4, 6, 3, 7, 2, 5, 0] (Fitness: 323846)

98 | [8, 4, 2, 10, 1, 9, 6, 11, 7, 3, 5, 0] (Fitness: 324672)

99 | [8, 4, 2, 10, 1, 9, 6, 11, 7, 3, 5, 0] (Fitness: 324672)

## Tabla resumen:

|  |  |  |
| --- | --- | --- |
| Nº Ejecución | Individuo | Aptitud |
| 1 | [6, 2, 10, 0, 4, 8, 5, 3, 1, 7, 11, 9] | 238270 |
| 2 | [10, 11, 3, 0, 8, 9, 5, 7, 1, 4, 2, 6] | 233848 |
| 3 | [1, 9, 4, 3, 5, 11, 8, 0, 10, 7, 6, 2] | 239302 |
| 4 | [10, 7, 3, 0, 8, 5, 9, 4, 6, 11, 2, 1] | 234788 |
| 5 | [9, 2, 10, 11, 5, 4, 1, 3, 8, 7, 0, 6] | 237756 |
| 6 | [10, 11, 3, 0, 8, 9, 5, 7, 1, 4, 2, 6] | 233848 |
| 7 | [7, 3, 8, 11, 1, 2, 9, 0, 6, 4, 5, 10] | 229092 |
| 8 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] | 224416 |
| 9 | [10, 11, 3, 0, 1, 9, 4, 8, 7, 5, 2, 6] | 230704 |
| 10 | [7, 3, 8, 11, 1, 2, 9, 0, 6, 4, 5, 10] | 229092 |
| 11 | [1, 2, 7, 0, 4, 9, 10, 8, 6, 11, 5, 3] | 240492 |
| 12 | [10, 11, 3, 0, 1, 9, 4, 8, 7, 5, 2, 6] | 230704 |
| 13 | [6, 7, 4, 0, 10, 5, 9, 8, 3, 2, 11, 1] | 241360 |
| 14 | [2, 4, 9, 3, 8, 7, 10, 0, 6, 11, 5, 1] | 243460 |
| 15 | [9, 3, 5, 0, 2, 6, 8, 7, 1, 4, 11, 10] | 236006 |
| 16 | [10, 7, 3, 0, 8, 5, 9, 4, 6, 11, 2, 1] | 234788 |
| 17 | [10, 11, 3, 0, 1, 9, 4, 8, 7, 5, 2, 6] | 230704 |
| 18 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] | 224416 |
| 19 | [9, 11, 5, 0, 10, 1, 4, 8, 3, 7, 2, 6] | 235554 |
| 20 | [1, 3, 6, 11, 7, 2, 9, 0, 8, 5, 4, 10] | 224416 |

**Mejor solución:** 224416

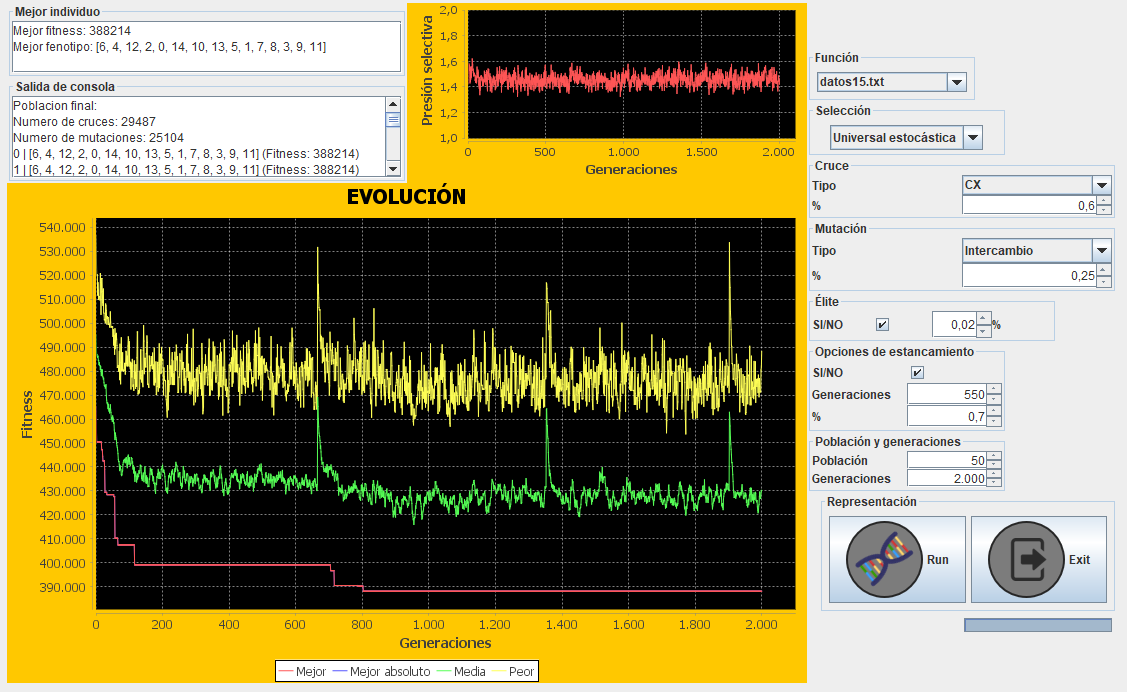
**Peor solución:** 243460

**Media:** 233650.8

**Desviación típica:** 5513.0485

# Problema 2: datos15.dat

## Ejecución representativa:



**Individuo solución:** [6, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 9, 11]

**Aptitud máxima:** 388214

**Aptitud media:** 430203.52

**Aptitud mínima:** 488198

**Numero de cruces:** 29487

**Numero de mutaciones:** 25104

**Población final:**

0 | [6, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 9, 11] (Fitness: 388214)

1 | [6, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 9, 11] (Fitness: 388214)

2 | [6, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 9, 11] (Fitness: 388214)

3 | [6, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 9, 11] (Fitness: 388214)

4 | [6, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 9, 11] (Fitness: 388214)

5 | [9, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 6, 11] (Fitness: 396320)

6 | [9, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 6, 11] (Fitness: 396320)

7 | [10, 4, 12, 2, 0, 14, 9, 13, 5, 1, 7, 8, 3, 6, 11] (Fitness: 398432)

8 | [6, 4, 12, 2, 0, 14, 8, 13, 5, 1, 7, 10, 3, 9, 11] (Fitness: 399236)

9 | [6, 4, 12, 3, 0, 14, 10, 13, 5, 1, 7, 8, 2, 9, 11] (Fitness: 402462)

10 | [6, 4, 12, 2, 7, 0, 10, 9, 5, 1, 13, 8, 3, 14, 11] (Fitness: 405898)

11 | [6, 4, 12, 8, 0, 14, 10, 13, 5, 1, 7, 2, 3, 9, 11] (Fitness: 405980)

12 | [6, 4, 12, 8, 0, 14, 10, 13, 5, 1, 7, 2, 3, 9, 11] (Fitness: 405980)

13 | [6, 4, 12, 2, 0, 14, 10, 13, 7, 1, 5, 8, 3, 9, 11] (Fitness: 410200)

14 | [6, 4, 12, 2, 0, 9, 10, 13, 5, 1, 7, 8, 3, 14, 11] (Fitness: 411476)

15 | [6, 4, 12, 2, 0, 9, 10, 13, 5, 1, 7, 8, 3, 14, 11] (Fitness: 411476)

16 | [6, 4, 12, 2, 0, 14, 10, 13, 5, 9, 7, 8, 3, 1, 11] (Fitness: 412628)

17 | [6, 4, 12, 2, 0, 14, 10, 13, 11, 1, 7, 8, 3, 9, 5] (Fitness: 415776)

18 | [6, 4, 12, 2, 0, 11, 10, 13, 5, 8, 7, 1, 3, 9, 14] (Fitness: 419188)

19 | [6, 1, 12, 2, 0, 14, 10, 13, 5, 4, 7, 8, 3, 9, 11] (Fitness: 421494)

20 | [6, 14, 12, 2, 0, 4, 10, 13, 5, 1, 7, 8, 3, 9, 11] (Fitness: 422024)

21 | [6, 4, 12, 2, 0, 14, 13, 11, 5, 1, 8, 10, 3, 9, 7] (Fitness: 423418)

22 | [0, 4, 12, 2, 6, 14, 10, 13, 5, 1, 7, 8, 3, 9, 11] (Fitness: 424664)

23 | [9, 4, 2, 12, 0, 14, 10, 13, 5, 1, 7, 8, 3, 6, 11] (Fitness: 430468)

24 | [14, 4, 12, 2, 0, 6, 10, 13, 5, 9, 7, 8, 3, 1, 11] (Fitness: 430712)

25 | [3, 4, 12, 2, 14, 11, 10, 9, 5, 1, 7, 8, 13, 6, 0] (Fitness: 430810)

26 | [9, 4, 1, 2, 0, 14, 10, 13, 5, 12, 7, 8, 3, 6, 11] (Fitness: 431684)

27 | [6, 8, 9, 2, 0, 14, 10, 13, 5, 1, 7, 4, 3, 12, 11] (Fitness: 434238)

28 | [11, 8, 12, 2, 0, 14, 10, 5, 13, 1, 7, 4, 3, 9, 6] (Fitness: 434288)

29 | [3, 4, 12, 2, 13, 0, 10, 14, 5, 1, 7, 9, 6, 8, 11] (Fitness: 435106)

30 | [6, 1, 12, 2, 4, 14, 10, 13, 5, 0, 7, 8, 3, 9, 11] (Fitness: 435936)

31 | [6, 4, 12, 1, 0, 14, 10, 13, 5, 8, 7, 2, 3, 9, 11] (Fitness: 437544)

32 | [6, 4, 13, 2, 0, 11, 10, 12, 5, 1, 14, 8, 3, 9, 7] (Fitness: 438358)

33 | [9, 4, 5, 2, 12, 7, 10, 13, 0, 1, 14, 8, 3, 6, 11] (Fitness: 440144)

34 | [6, 4, 8, 12, 0, 14, 10, 13, 5, 9, 7, 2, 3, 1, 11] (Fitness: 440552)

35 | [12, 4, 9, 2, 0, 14, 10, 13, 1, 5, 7, 8, 3, 6, 11] (Fitness: 444266)

36 | [3, 4, 12, 2, 0, 14, 10, 7, 5, 1, 6, 11, 8, 9, 13] (Fitness: 448348)

37 | [6, 10, 12, 4, 0, 7, 2, 13, 5, 1, 14, 8, 3, 9, 11] (Fitness: 455214)

38 | [3, 4, 12, 2, 7, 14, 0, 8, 5, 1, 10, 13, 6, 9, 11] (Fitness: 459726)

39 | [6, 4, 12, 5, 11, 14, 10, 2, 13, 1, 7, 0, 3, 9, 8] (Fitness: 461144)

40 | [10, 14, 12, 2, 9, 4, 6, 13, 7, 1, 5, 8, 3, 0, 11] (Fitness: 461972)

41 | [9, 10, 1, 2, 0, 14, 8, 13, 5, 12, 7, 4, 3, 6, 11] (Fitness: 462468)

42 | [2, 6, 12, 4, 8, 14, 10, 13, 5, 1, 7, 0, 3, 9, 11] (Fitness: 463932)

43 | [14, 4, 3, 2, 0, 8, 10, 13, 1, 5, 7, 11, 12, 9, 6] (Fitness: 464622)

44 | [9, 4, 3, 2, 6, 14, 10, 13, 8, 1, 7, 5, 12, 0, 11] (Fitness: 464820)

45 | [12, 4, 6, 2, 0, 11, 10, 14, 8, 5, 13, 1, 3, 9, 7] (Fitness: 468120)

46 | [6, 4, 12, 2, 7, 14, 10, 1, 9, 13, 11, 8, 3, 5, 0] (Fitness: 471424)

47 | [6, 5, 1, 8, 7, 14, 10, 3, 4, 12, 0, 2, 9, 13, 11] (Fitness: 471704)

48 | [6, 4, 10, 2, 0, 14, 12, 13, 5, 11, 7, 8, 3, 9, 1] (Fitness: 480336)

49 | [9, 4, 12, 0, 2, 3, 10, 11, 14, 1, 7, 8, 6, 5, 13] (Fitness: 488198)

## Tabla resumen:

|  |  |  |
| --- | --- | --- |
| Nº Ejecución | Individuo | Aptitud |
| 1 | [5, 0, 12, 7, 4, 3, 6, 11, 8, 9, 13, 14, 1, 10, 2] | 396492 |
| 2 | [13, 0, 12, 2, 8, 4, 6, 5, 3, 10, 11, 7, 1, 9, 14] | 394654 |
| 3 | [13, 0, 12, 2, 8, 4, 6, 5, 3, 10, 11, 7, 1, 9, 14] | 394654 |
| 4 | [14, 4, 13, 7, 12, 2, 6, 11, 1, 0, 8, 9, 10, 5, 3] | 399670 |
| 5 | [3, 0, 13, 11, 12, 4, 6, 7, 8, 9, 14, 5, 10, 1, 2] | 394658 |
| 6 | [8, 7, 12, 0, 6, 1, 4, 13, 3, 11, 10, 14, 2, 5, 9] | 401276 |
| 7 | [13, 8, 14, 11, 12, 3, 10, 4, 9, 0, 2, 5, 6, 7, 1] | 391586 |
| 8 | [9, 1, 12, 14, 4, 2, 6, 10, 13, 11, 8, 7, 0, 5, 3] | 392520 |
| 9 | [6, 8, 4, 2, 12, 7, 5, 3, 0, 10, 1, 11, 13, 9, 14] | 401936 |
| 10 | [6, 4, 12, 3, 9, 0, 8, 7, 5, 1, 13, 14, 2, 10, 11] | 391744 |
| 11 | [0, 8, 4, 11, 12, 2, 6, 14, 13, 7, 1, 5, 10, 9, 3] | 391288 |
| 12 | [0, 11, 2, 8, 1, 3, 10, 6, 14, 13, 9, 5, 4, 7, 12] | 395612 |
| 13 | [12, 5, 13, 8, 1, 6, 4, 2, 7, 3, 10, 11, 0, 14, 9] | 399452 |
| 14 | [6, 4, 12, 2, 0, 14, 10, 13, 5, 1, 7, 8, 3, 9, 11] | 388214 |
| 15 | [9, 3, 2, 4, 7, 0, 8, 1, 11, 10, 14, 13, 5, 6, 12] | 391170 |
| 16 | [8, 6, 7, 12, 11, 0, 10, 9, 2, 14, 5, 1, 3, 4, 13] | 404332 |
| 17 | [9, 13, 12, 0, 14, 3, 10, 7, 1, 11, 4, 5, 6, 8, 2] | 404012 |
| 18 | [8, 4, 12, 7, 0, 3, 10, 5, 1, 11, 13, 14, 9, 6, 2] | 402290 |
| 19 | [8, 5, 13, 9, 7, 6, 2, 4, 1, 11, 14, 10, 3, 12, 0] | 398010 |
| 20 | [10, 9, 0, 6, 14, 11, 3, 1, 4, 8, 12, 5, 13, 2, 7] | 405440 |

**Mejor solución:** 388214

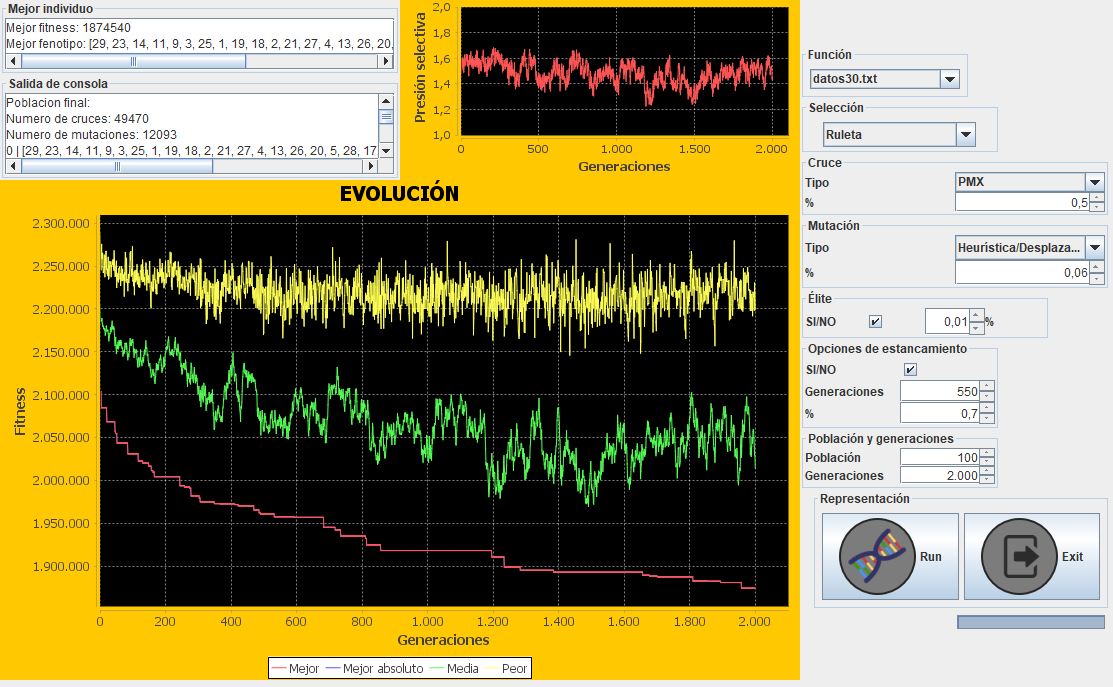
**Peor solución:** 405440

**Media:** 396950.5

**Desviación típica:** 4991.986653628

# Problema 3: datos30.dat

## Ejecución representativa:



**Individuo solución:** [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6]

**Aptitud máxima:** 1874540

**Aptitud media:** 2014473.68

**Aptitud mínima:** 2198958

**Numero de cruces:** 49470

**Numero de mutaciones:** 12093

**Población final:**

0 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1874540)

1 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1874540)

2 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1874540)

3 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1874540)

4 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1874540)

5 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1874540)

6 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1874540)

7 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1874540)

8 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 0, 15, 22, 6] (Fitness: 1898796)

9 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 0, 15, 22, 6] (Fitness: 1898796)

10 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 6, 22, 15] (Fitness: 1906110)

11 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 5, 4, 13, 26, 20, 27, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1909386)

12 | [29, 23, 14, 7, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 11, 16, 6, 10, 12, 24, 0, 15, 22, 8] (Fitness: 1911564)

13 | [29, 6, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 23] (Fitness: 1920704)

14 | [29, 6, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 23] (Fitness: 1920704)

15 | [29, 23, 14, 11, 9, 3, 26, 1, 25, 18, 2, 21, 27, 4, 13, 19, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] (Fitness: 1920890)

16 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 22, 15, 6] (Fitness: 1921586)

17 | [29, 23, 14, 6, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 11, 22, 15] (Fitness: 1922730)

18 | [29, 23, 14, 11, 9, 3, 19, 1, 25, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 24, 8, 10, 12, 16, 0, 15, 22, 6] (Fitness: 1926204)

19 | [29, 23, 14, 11, 9, 3, 19, 1, 25, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 15, 24, 0, 12, 22, 6] (Fitness: 1928222)

20 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 0, 6, 22, 15] (Fitness: 1931556)

21 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 0, 6, 22, 15] (Fitness: 1931556)

22 | [6, 23, 14, 11, 9, 3, 25, 1, 26, 18, 2, 21, 27, 4, 13, 19, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 29] (Fitness: 1936576)

23 | [6, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 24, 8, 10, 12, 16, 0, 15, 22, 29] (Fitness: 1940618)

24 | [6, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 24, 8, 10, 12, 16, 0, 15, 22, 29] (Fitness: 1940618)

25 | [6, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 24, 8, 10, 12, 16, 0, 15, 22, 29] (Fitness: 1940618)

26 | [6, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 24, 8, 10, 12, 16, 0, 15, 22, 29] (Fitness: 1940618)

27 | [6, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 24, 8, 10, 12, 16, 0, 15, 22, 29] (Fitness: 1940618)

28 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 6, 22, 15, 0] (Fitness: 1950322)

29 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 24, 8, 10, 12, 16, 0, 6, 22, 15] (Fitness: 1953356)

30 | [6, 20, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 23, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 29, 22, 15] (Fitness: 1962814)

31 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 5, 4, 13, 26, 20, 27, 28, 17, 7, 16, 8, 10, 24, 12, 0, 6, 22, 15] (Fitness: 1963174)

32 | [29, 23, 14, 11, 9, 3, 0, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 25, 6, 22, 15] (Fitness: 1963868)

33 | [29, 23, 14, 11, 9, 3, 19, 1, 25, 18, 2, 21, 27, 0, 13, 26, 20, 5, 28, 17, 7, 16, 8, 12, 24, 22, 4, 15, 10, 6] (Fitness: 1967132)

34 | [29, 10, 14, 0, 9, 3, 25, 1, 19, 18, 2, 21, 5, 4, 13, 26, 20, 27, 28, 17, 7, 16, 8, 22, 12, 24, 11, 15, 23, 6] (Fitness: 1971730)

35 | [29, 6, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 15, 12, 0, 24, 22, 23] (Fitness: 1973908)

36 | [6, 23, 14, 9, 11, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 24, 8, 10, 12, 16, 0, 15, 22, 29] (Fitness: 1974356)

37 | [29, 23, 14, 11, 9, 3, 0, 19, 26, 18, 2, 21, 27, 4, 13, 1, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 25, 15, 22, 6] (Fitness: 1977374)

38 | [29, 23, 22, 7, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 11, 16, 8, 10, 24, 12, 0, 6, 14, 15] (Fitness: 1984368)

39 | [29, 23, 22, 7, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 11, 16, 8, 10, 24, 12, 0, 6, 14, 15] (Fitness: 1984368)

40 | [11, 23, 14, 15, 9, 3, 25, 1, 19, 18, 2, 21, 0, 4, 13, 26, 20, 5, 28, 17, 7, 29, 16, 10, 12, 6, 27, 22, 8, 24] (Fitness: 1985328)

41 | [11, 23, 14, 15, 9, 3, 25, 1, 19, 18, 2, 21, 0, 4, 13, 26, 20, 5, 28, 17, 7, 29, 16, 10, 12, 6, 27, 22, 8, 24] (Fitness: 1985328)

42 | [29, 23, 15, 7, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 11, 16, 8, 10, 24, 12, 0, 6, 14, 22] (Fitness: 1989226)

43 | [12, 29, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 23, 28, 17, 7, 16, 8, 10, 22, 24, 0, 6, 5, 15] (Fitness: 1989810)

44 | [29, 23, 14, 6, 9, 3, 0, 1, 19, 18, 2, 21, 27, 16, 13, 26, 20, 5, 28, 17, 7, 11, 8, 10, 12, 24, 25, 22, 15, 4] (Fitness: 1991810)

45 | [29, 23, 14, 6, 9, 3, 0, 1, 19, 18, 2, 21, 27, 16, 13, 26, 20, 5, 28, 17, 7, 11, 8, 10, 12, 24, 25, 22, 15, 4] (Fitness: 1991810)

46 | [29, 1, 22, 11, 9, 3, 25, 23, 19, 18, 2, 21, 27, 0, 13, 26, 20, 5, 28, 17, 7, 16, 6, 10, 12, 24, 4, 15, 14, 8] (Fitness: 1992492)

47 | [8, 15, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 23, 5, 28, 17, 7, 29, 16, 10, 12, 24, 0, 20, 22, 6] (Fitness: 1996588)

48 | [8, 15, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 23, 5, 28, 17, 7, 29, 16, 10, 12, 24, 0, 20, 22, 6] (Fitness: 1996588)

49 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 0, 4, 13, 26, 20, 5, 28, 17, 7, 16, 10, 15, 12, 27, 24, 22, 8, 6] (Fitness: 2019208)

50 | [29, 1, 14, 11, 9, 25, 10, 23, 19, 18, 2, 21, 27, 0, 13, 26, 20, 5, 28, 17, 7, 16, 8, 12, 24, 22, 4, 15, 3, 6] (Fitness: 2019814)

51 | [29, 1, 14, 11, 9, 25, 10, 23, 19, 18, 2, 21, 27, 0, 13, 26, 20, 5, 28, 17, 7, 16, 8, 12, 24, 22, 4, 15, 3, 6] (Fitness: 2019814)

52 | [25, 20, 14, 11, 9, 3, 29, 23, 19, 18, 2, 21, 27, 4, 13, 26, 1, 5, 28, 17, 7, 16, 6, 10, 12, 8, 0, 24, 22, 15] (Fitness: 2020354)

53 | [29, 12, 14, 11, 9, 0, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 10, 28, 17, 7, 16, 8, 5, 24, 6, 3, 15, 22, 23] (Fitness: 2022456)

54 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 7, 5, 28, 17, 16, 8, 12, 15, 24, 6, 22, 10, 0] (Fitness: 2022794)

55 | [29, 18, 14, 6, 9, 3, 25, 1, 19, 4, 11, 21, 2, 27, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 0, 15, 22, 23] (Fitness: 2025254)

56 | [8, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 13, 26, 6, 15, 5, 28, 17, 7, 29, 16, 10, 12, 24, 0, 20, 22, 4] (Fitness: 2026296)

57 | [29, 0, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 15, 7, 16, 6, 23, 12, 24, 10, 22, 17, 8] (Fitness: 2031830)

58 | [29, 23, 10, 11, 9, 3, 26, 1, 25, 16, 2, 21, 27, 4, 13, 19, 20, 5, 28, 17, 7, 18, 8, 12, 24, 22, 0, 15, 14, 6] (Fitness: 2034232)

59 | [29, 1, 14, 11, 9, 25, 12, 23, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 15, 24, 6, 22, 3, 0] (Fitness: 2039392)

60 | [29, 10, 14, 0, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 15, 7, 16, 6, 23, 12, 24, 11, 17, 22, 8] (Fitness: 2041692)

61 | [29, 23, 14, 11, 9, 3, 0, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 7, 5, 28, 17, 16, 8, 12, 15, 24, 6, 22, 10, 25] (Fitness: 2048862)

62 | [29, 23, 14, 11, 9, 3, 0, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 7, 5, 28, 17, 16, 8, 12, 15, 24, 6, 22, 10, 25] (Fitness: 2048862)

63 | [29, 23, 14, 11, 9, 3, 0, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 7, 5, 28, 17, 16, 8, 12, 15, 24, 6, 22, 10, 25] (Fitness: 2048862)

64 | [24, 1, 14, 6, 9, 3, 25, 23, 19, 18, 2, 21, 27, 4, 13, 26, 12, 5, 11, 17, 7, 16, 20, 10, 28, 0, 29, 8, 22, 15] (Fitness: 2049910)

65 | [29, 23, 14, 11, 9, 3, 19, 1, 21, 0, 13, 26, 27, 4, 2, 25, 12, 28, 5, 17, 7, 18, 8, 10, 24, 20, 16, 15, 22, 6] (Fitness: 2053300)

66 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 22, 26, 5, 28, 17, 7, 16, 8, 10, 13, 12, 24, 0, 15, 20, 6] (Fitness: 2053430)

67 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 4, 6, 21, 2, 27, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 0, 22, 15, 18] (Fitness: 2054530)

68 | [24, 1, 14, 6, 9, 3, 25, 7, 19, 18, 2, 21, 27, 4, 13, 26, 12, 28, 17, 15, 5, 16, 20, 10, 11, 0, 29, 8, 22, 23] (Fitness: 2064476)

69 | [6, 1, 14, 0, 9, 3, 25, 23, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 15, 7, 24, 8, 10, 12, 16, 11, 17, 22, 29] (Fitness: 2067542)

70 | [20, 25, 14, 11, 9, 22, 2, 1, 21, 19, 18, 4, 27, 13, 26, 23, 29, 5, 28, 17, 7, 16, 8, 10, 24, 12, 0, 6, 3, 15] (Fitness: 2069652)

71 | [29, 23, 14, 6, 9, 3, 25, 1, 19, 4, 11, 21, 2, 27, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 24, 12, 0, 22, 15, 18] (Fitness: 2071866)

72 | [23, 15, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 20, 5, 28, 17, 7, 16, 29, 8, 10, 12, 24, 26, 22, 0, 6] (Fitness: 2073116)

73 | [29, 23, 14, 16, 9, 3, 19, 1, 25, 18, 2, 21, 27, 13, 26, 20, 8, 5, 28, 17, 7, 6, 11, 10, 12, 15, 24, 0, 4, 22] (Fitness: 2081370)

74 | [4, 23, 14, 9, 3, 11, 25, 1, 19, 18, 2, 21, 27, 13, 26, 6, 15, 5, 17, 28, 7, 16, 8, 10, 12, 24, 0, 20, 22, 29] (Fitness: 2082932)

75 | [29, 23, 6, 11, 9, 3, 26, 1, 25, 16, 2, 21, 0, 4, 13, 19, 20, 5, 28, 17, 7, 18, 10, 15, 12, 27, 24, 22, 8, 14] (Fitness: 2084036)

76 | [29, 10, 22, 0, 9, 3, 25, 1, 19, 24, 2, 21, 27, 4, 13, 26, 20, 5, 28, 15, 7, 16, 6, 23, 12, 18, 11, 17, 14, 8] (Fitness: 2087088)

77 | [29, 23, 12, 11, 9, 3, 25, 1, 19, 17, 2, 21, 0, 4, 13, 26, 20, 5, 28, 18, 7, 16, 15, 8, 24, 22, 27, 10, 14, 6] (Fitness: 2087450)

78 | [24, 1, 14, 6, 9, 3, 25, 23, 19, 18, 2, 21, 27, 4, 13, 26, 12, 28, 17, 15, 5, 16, 20, 10, 7, 0, 29, 8, 22, 11] (Fitness: 2091844)

79 | [24, 1, 14, 6, 9, 3, 25, 23, 19, 18, 2, 21, 27, 4, 13, 26, 12, 28, 17, 15, 5, 16, 20, 10, 7, 0, 29, 8, 22, 11] (Fitness: 2091844)

80 | [23, 10, 14, 19, 9, 3, 6, 1, 29, 2, 25, 21, 27, 4, 13, 26, 20, 5, 11, 17, 7, 28, 15, 8, 24, 12, 22, 0, 16, 18] (Fitness: 2094452)

81 | [23, 15, 14, 11, 9, 3, 0, 19, 26, 18, 2, 21, 27, 4, 13, 20, 5, 28, 17, 7, 16, 29, 8, 10, 12, 24, 1, 22, 25, 6] (Fitness: 2098620)

82 | [0, 11, 23, 22, 9, 14, 20, 26, 19, 18, 2, 21, 27, 4, 13, 6, 15, 5, 28, 17, 7, 24, 8, 10, 12, 1, 3, 16, 29, 25] (Fitness: 2101664)

83 | [0, 11, 23, 22, 9, 14, 20, 26, 19, 18, 2, 21, 27, 4, 13, 6, 15, 5, 28, 17, 7, 24, 8, 10, 12, 1, 3, 16, 29, 25] (Fitness: 2101664)

84 | [0, 11, 23, 22, 9, 14, 20, 26, 19, 18, 2, 21, 27, 4, 13, 6, 15, 5, 28, 17, 7, 24, 8, 10, 12, 1, 3, 16, 29, 25] (Fitness: 2101664)

85 | [12, 23, 14, 11, 9, 3, 0, 1, 21, 19, 18, 4, 27, 13, 26, 20, 29, 25, 28, 17, 7, 16, 8, 10, 22, 24, 2, 6, 5, 15] (Fitness: 2104222)

86 | [12, 20, 14, 11, 9, 22, 2, 1, 21, 19, 18, 4, 27, 13, 26, 23, 29, 25, 28, 17, 7, 16, 8, 10, 3, 24, 0, 6, 5, 15] (Fitness: 2110062)

87 | [29, 23, 12, 11, 9, 3, 25, 1, 19, 17, 2, 21, 4, 13, 26, 0, 20, 5, 28, 18, 7, 16, 15, 8, 24, 22, 27, 10, 14, 6] (Fitness: 2112042)

88 | [29, 3, 23, 11, 25, 1, 19, 2, 9, 6, 21, 14, 4, 27, 26, 13, 20, 5, 28, 17, 7, 16, 8, 10, 12, 18, 0, 24, 15, 22] (Fitness: 2114402)

89 | [6, 14, 9, 11, 3, 23, 19, 1, 25, 18, 2, 21, 27, 13, 26, 20, 8, 5, 28, 17, 7, 29, 16, 10, 12, 15, 24, 0, 4, 22] (Fitness: 2117956)

90 | [6, 23, 14, 11, 9, 3, 25, 1, 19, 4, 16, 21, 2, 27, 13, 26, 20, 5, 28, 15, 24, 18, 10, 7, 12, 17, 29, 22, 8, 0] (Fitness: 2118322)

91 | [1, 6, 3, 11, 14, 9, 25, 23, 19, 18, 2, 21, 27, 4, 13, 26, 20, 7, 5, 28, 17, 16, 8, 12, 15, 10, 0, 24, 22, 29] (Fitness: 2145086)

92 | [18, 23, 14, 7, 9, 3, 19, 1, 29, 2, 25, 21, 27, 4, 13, 26, 20, 28, 17, 15, 5, 16, 6, 10, 12, 8, 0, 24, 22, 11] (Fitness: 2151178)

93 | [29, 20, 14, 11, 9, 22, 25, 2, 1, 18, 0, 21, 27, 4, 13, 19, 26, 23, 7, 5, 28, 17, 16, 8, 12, 15, 24, 6, 3, 10] (Fitness: 2172130)

94 | [18, 23, 14, 11, 9, 19, 1, 2, 25, 21, 27, 20, 4, 13, 26, 3, 5, 28, 17, 7, 29, 0, 16, 6, 10, 12, 8, 24, 22, 15] (Fitness: 2179392)

95 | [29, 12, 8, 26, 21, 9, 3, 23, 25, 1, 11, 19, 2, 17, 0, 4, 13, 20, 5, 18, 7, 16, 24, 22, 27, 10, 28, 14, 15, 6] (Fitness: 2181810)

96 | [1, 29, 11, 9, 3, 6, 19, 24, 18, 2, 21, 14, 4, 27, 26, 20, 5, 28, 17, 7, 16, 8, 10, 13, 12, 15, 0, 22, 23, 25] (Fitness: 2188540)

97 | [24, 2, 23, 8, 9, 14, 28, 5, 11, 13, 7, 17, 18, 1, 21, 4, 3, 26, 20, 27, 19, 16, 22, 10, 15, 12, 0, 6, 29, 25] (Fitness: 2192042)

98 | [29, 3, 23, 11, 25, 1, 19, 2, 9, 6, 21, 14, 4, 27, 26, 20, 5, 28, 17, 7, 16, 8, 10, 13, 12, 24, 0, 18, 15, 22] (Fitness: 2198514)

99 | [3, 11, 20, 19, 9, 6, 27, 25, 13, 1, 14, 28, 21, 29, 4, 7, 16, 26, 8, 15, 24, 23, 0, 18, 17, 5, 2, 12, 10, 22] (Fitness: 2198958)

## Tabla resumen:

|  |  |  |
| --- | --- | --- |
| Nº Ejecución | Individuo | Aptitud |
| 1 | [6, 20, 27, 19, 28, 21, 3, 2, 4, 8, 7, 23, 11, 24, 12, 5, 18, 29, 25, 10, 1, 9, 26, 16, 0, 17, 22, 14, 15, 13] | 1916578 |
| 2 | [14, 18, 25, 8, 11, 7, 12, 1, 9, 16, 15, 4, 10, 17, 27, 20, 21, 0, 6, 23, 5, 29, 26, 24, 3, 2, 19, 13, 22, 28] | 1888216 |
| 3 | [0, 11, 1, 4, 26, 25, 21, 18, 28, 16, 29, 12, 17, 15, 20, 9, 10, 22, 5, 8, 24, 3, 13, 7, 2, 19, 27, 23, 6, 14] | 1905400 |
| 4 | [13, 11, 12, 6, 26, 29, 9, 21, 23, 1, 4, 19, 18, 22, 24, 16, 7, 15, 25, 5, 3, 20, 17, 0, 2, 28, 27, 14, 8, 10] | 1912518 |
| 5 | [8, 6, 25, 17, 7, 9, 11, 5, 27, 2, 12, 18, 16, 14, 24, 15, 26, 23, 4, 20, 3, 21, 29, 1, 0, 10, 19, 13, 22, 28] | 1918272 |
| 6 | [27, 19, 0, 21, 22, 18, 23, 3, 15, 9, 17, 10, 1, 29, 20, 8, 24, 2, 28, 6, 7, 5, 14, 16, 4, 13, 11, 12, 25, 26] | 1910258 |
| 7 | [18, 20, 1, 4, 29, 19, 8, 10, 9, 0, 3, 21, 5, 15, 24, 23, 17, 25, 27, 13, 12, 26, 2, 22, 28, 6, 16, 11, 14, 7] | 1903182 |
| 8 | [0, 2, 13, 15, 9, 7, 6, 16, 14, 19, 3, 18, 21, 4, 23, 22, 1, 10, 8, 25, 17, 28, 12, 20, 26, 29, 27, 5, 24, 11] | 1909976 |
| 9 | [17, 19, 9, 26, 25, 15, 11, 0, 6, 27, 3, 16, 29, 7, 12, 8, 1, 21, 5, 24, 22, 4, 14, 23, 20, 13, 18, 28, 10, 2] | 1894928 |
| 10 | [17, 6, 12, 2, 9, 27, 16, 19, 8, 13, 11, 1, 0, 26, 3, 24, 10, 18, 7, 23, 28, 4, 25, 14, 5, 29, 21, 22, 20, 15] | 1902742 |
| 11 | [23, 14, 1, 9, 25, 28, 11, 8, 6, 21, 19, 3, 17, 18, 12, 15, 2, 22, 20, 24, 27, 26, 29, 16, 4, 13, 10, 7, 5, 0] | 1907024 |
| 12 | [14, 8, 25, 11, 26, 28, 4, 19, 13, 20, 5, 0, 22, 24, 27, 16, 21, 12, 2, 10, 18, 23, 1, 7, 15, 3, 29, 9, 17, 6] | 1907448 |
| 13 | [29, 23, 14, 11, 9, 3, 25, 1, 19, 18, 2, 21, 27, 4, 13, 26, 20, 5, 28, 17, 7, 16, 8, 10, 12, 24, 0, 15, 22, 6] | 1874540 |
| 14 | [5, 27, 23, 2, 11, 7, 4, 1, 24, 0, 20, 18, 25, 13, 14, 3, 12, 10, 6, 16, 17, 29, 26, 15, 8, 19, 22, 9, 21, 28] | 1876188 |
| 15 | [11, 15, 1, 8, 23, 9, 4, 22, 12, 16, 28, 19, 5, 10, 27, 26, 20, 6, 2, 0, 17, 29, 21, 24, 25, 3, 14, 18, 7, 13] | 1898272 |
| 16 | [10, 27, 12, 20, 4, 3, 19, 15, 28, 22, 7, 9, 17, 14, 13, 5, 8, 18, 1, 25, 2, 26, 23, 0, 11, 16, 6, 21, 29, 24] | 1914482 |
| 17 | [29, 20, 6, 26, 18, 14, 9, 7, 0, 13, 17, 5, 25, 16, 8, 28, 24, 3, 2, 1, 10, 15, 22, 12, 21, 23, 11, 19, 27, 4] | 1890264 |
| 18 | [14, 5, 0, 25, 4, 6, 2, 1, 24, 16, 19, 17, 15, 20, 29, 11, 21, 7, 8, 10, 18, 23, 26, 9, 3, 27, 22, 13, 12, 28] | 1880728 |
| 19 | [17, 18, 1, 0, 4, 13, 29, 8, 11, 27, 24, 22, 7, 16, 19, 3, 28, 15, 6, 20, 14, 9, 25, 12, 26, 5, 23, 10, 2, 21] | 1899872 |
| 20 | [17, 18, 1, 0, 4, 13, 29, 8, 11, 27, 24, 22, 7, 16, 19, 3, 28, 15, 6, 20, 14, 9, 25, 12, 26, 5, 23, 10, 2, 21] | 1899872 |

**Mejor solución:** 1874540

**Peor solución:** 1918272

**Media:** 1900538

**Desviación típica:** 12599.0578