Programación Evolutiva

Práctica 2

Grupo 08

Miguel Ángel Castillo Moreno

Juan Pedro Olmos Rojas

# Introducción:

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

- **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, por lo que introducimos el escalado lineal en la ruleta, selección universal estocástica.

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

**- Gráfico de presión selectiva**: muestra con un valor entre 2 y 1 lo cerca que está la media de los mínimos y máximos. Un valor cercano a 1 significa que hay poca diversidad y la media se acerca mucho al máximo, mientras que un valor cercano a 2, significa que hay demasiada diversidad, por tanto, 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 se mostrará aquí, pudiendo utilizarlo también para *debuguear*.

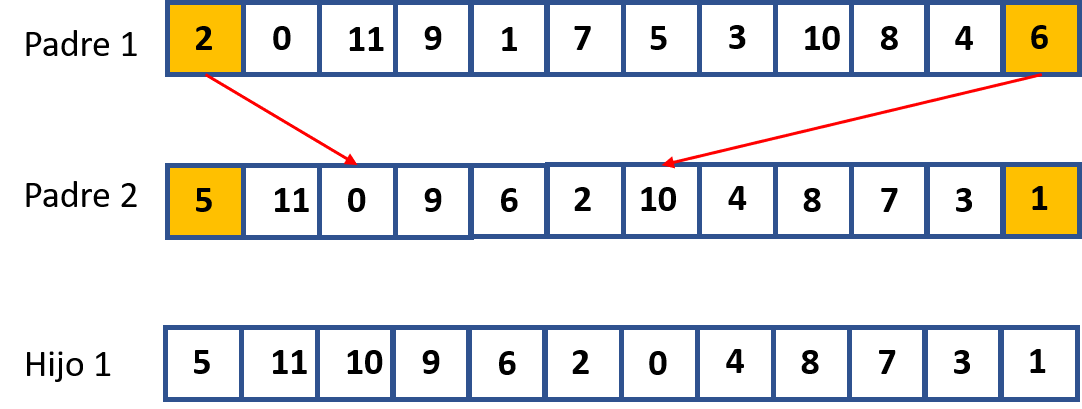
**- Barra de progreso:** al tener tiempos de ejecución elevados, debidos a algoritmos con individuos muy grandes o gran número de generaciones, necesitamos una indicación que nos asegure que se está realizando la evolución.

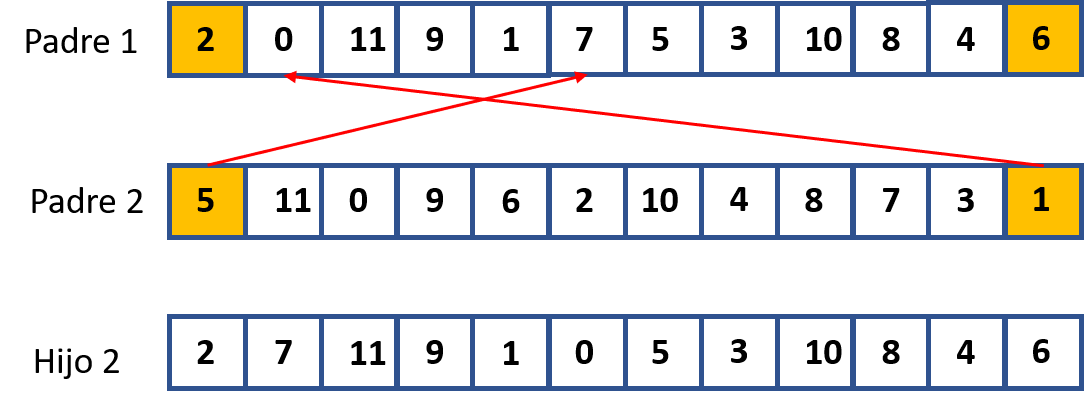
# Aclaraciones e interpretaciones

**Cruces**

**Corners:** método de cruce de invención propia que contempla las siguientes características:

* Se toman los valores de los extremos del individuo(padre).
* El hijo se genera intercambiando en el otro padre, las posiciones que indican los valores tomados.





**ERX:** en la implementación de este método se han aplicado los siguientes criterios:

* A la hora de realizar la tabla de conectividades, no se considera conexión circular. Es decir, el primer y último elemento no tienen proximidad.
* En la generación de los hijos, cuando se llega a un bloqueo, se vuelve a empezar de nuevo.
* Se establece un número de veces máximo en el que se reinicia la creación del hijo. Agotado este número de intentos, se establece como hijo los valores del padre contrario. Por tanto, para crear el primer hijo, partimos del primer valor del ‘padre 1’, si por bloqueos no se genera, asignamos al ‘hijo 1’, los valores del ‘padre 2’. Haciendo lo inverso en el caso del ‘hijo 2’.

**OX-OP:** se añade esta variante del cruce OX a la práctica.

**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:** similar a 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 mutaciones 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 óptimos, variando la selección, tipo de cruce y de mutación. También se ha priorizado el tiempo de ejecución, que se empieza a hacer cuantioso con individuos grandes y muchas generaciones. Por esto limitamos el número de generaciones a 2000 y el tamaño de la población a 100. Determinamos que estos valores ofrecen un tiempo de espera razonable para el usuario, obteniendo buenos resultados de igual manera.

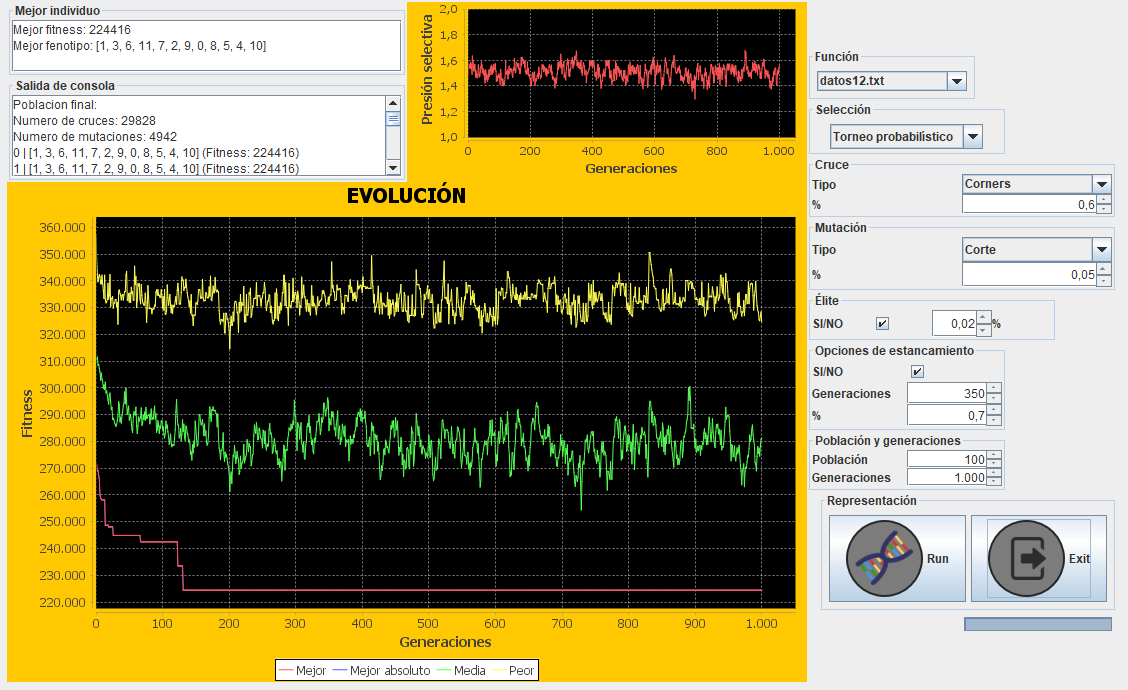
# RESULTADOS

A continuación, se exponen los resultados obtenidos para cada uno de los tres problemas dados. En cada uno de ellos se han realizado 20 ejecuciones con los parámetros que se muestran en las imágenes. Se ha tratado de mantener valores próximos a 1,5 en la gráfica de presión selectiva.

Se aporta en detalle los datos de la mejor ejecución y de manera resumida los resultados de todas las 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

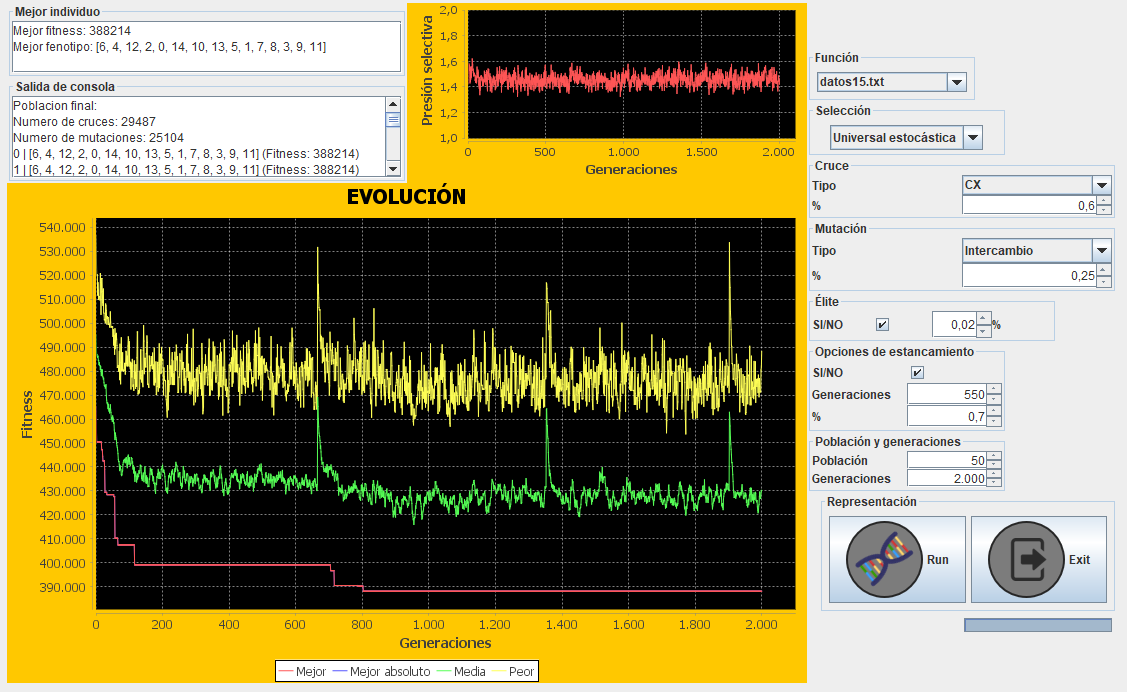
**Peor solución:** 243460

**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

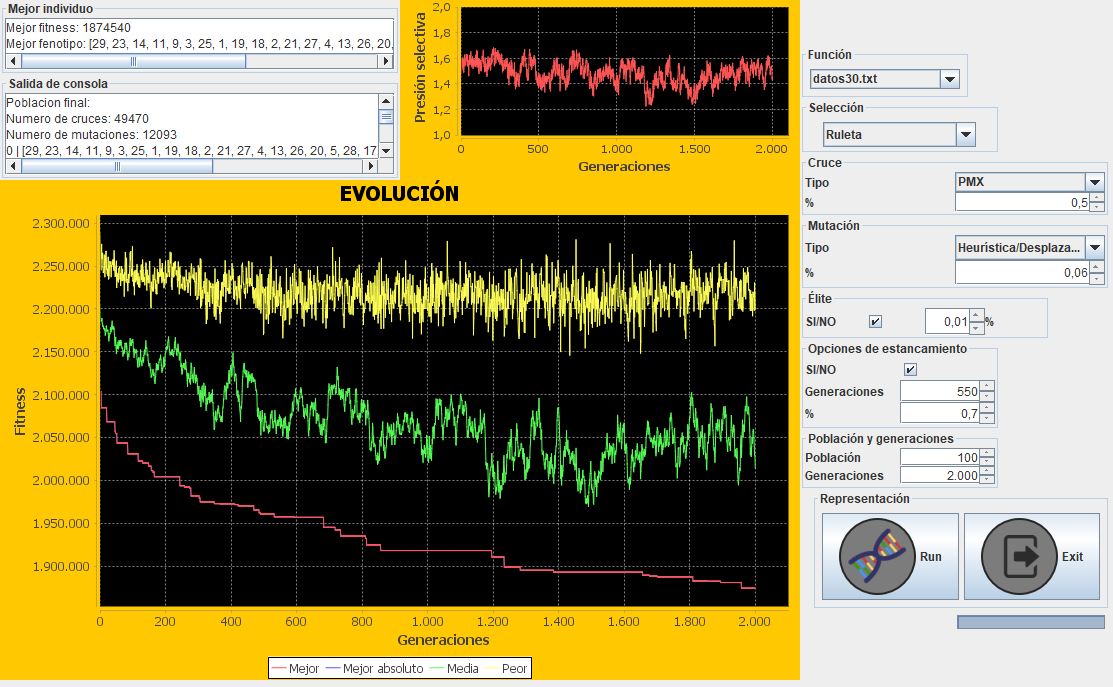
**Peor solución:** 405440

**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