Referências Bibliográficas

[1] SPEARS, W. et al. An Overview of Evolutionary Computation. In: SPRINGER-VERLAG. *Proceedings of the European Conference on Machine Learning*. London, UK, 1993. p. 442–459.

[2] MICHALEWICZ, Z. *Genetic algorithms+ data structures*. Berlin, Germany: Springer, 1996. ISBN 3-540-58090-5.

[3] BEYER, H.; SCHWEFEL, H. Evolution strategies–A comprehensive introduction. *Natural computing*, Springer, v. 1, n. 1, p. 3–52, 2002.

[4] YAO, X.; LIU, Y.; LIN, G. Evolutionary programming made faster. *Evolutionary Computation, IEEE Transactions on*, v. 3, n. 2, p. 82–102, jul 1999. ISSN 1089-778X.

[5] KOZA, J. R. *Genetic Programming: On the Programming of Computers by Means of Natural Selection*. Cambridge, MA, USA: MIT Press, 1992.

[6] BRAMEIER, M.; BANZHAF, W. *Linear Genetic Programming*. Boston, MA, USA: Springer, 2007. (Genetic and Evolutionary Computation, XVI).

[7] DIAS, D. M.; PACHECO, M. A. C.; AMARAL, J. F. M. Automatic synthesis of microcontroller assembly code through linear genetic programming. In: NEDJAH, N.; ABRAHAM, A.; MOURELLE, L. de M. (Ed.). *Genetic Systems Programming: Theory and Experiences*. Germany: Springer, 2006, (Studies in Computational Intelligence, v. 13). p. 195–234.

[8] BANZHAF, W. et al. *Genetic Programming – An Introduction; On the Automatic Evolution of Computer Programs and its Applications*. San Francisco, CA, USA: Morgan Kaufmann, dpunkt.verlag, 1998.

[9] CRAMER, N. A representation for the adaptive generation of simple sequential programs. In: L. ERLBAUM ASSOCIATES INC. *Proceedings of the 1st International Conference on Genetic Algorithms*. Pittsburgh, PA, USA, 1985. p. 183–187.

[10] KOZA, J. *Genetic programming: a paradigm for genetically breeding populations of computer programs to solve problems*. Stanford, CA, USA, june 1990.

[11] KOZA, J. R. Human-competitive results produced by genetic programming. *Genetic Programming and Evolvable Machines*, Springer Netherlands, v. 11, n. 3-4, p. 251–284, September 2010. ISSN 1389-2576.

[12] POLI, R.; LANGDON, W. B.; MCPHEE, N. F. *A field guide to genetic programming*. Published via `http://lulu.com`, 2008. (With contributions by J. R. Koza). Disponível em: <http://www.gp-field-guide.org.uk>.

[13] HAN, K.-H.; KIM, J.-H. Quantum-inspired evolutionary algorithm for a class of combinatorial optimization. *Evolutionary Computation, IEEE Transactions on*, v. 6, n. 6, p. 580–593, dec 2002.

[14] NARAYANAN, A.; MOORE, M. Quantum-inspired genetic algorithms. In: *Proceedings of 1996 IEEE International Conference on Evolutionary Computation (ICEC '96)*. Piscataway, NJ, USA: IEEE Press, 1996. p. 61–66.

[15] ABS DA CRUZ, A. V. et al. Quantum-inspired evolutionary algorithms and its application to numerical optimization problems. *LECTURE NOTES IN COMPUTER SCIENCE*, Springer, p. 212–217, 2004.

[16] ABS DA CRUZ, A. V.; VELLASCO, M. B. R.; PACHECO, M. A. C. Quantum-inspired evolutionary algorithm for numerical optimization. In: *IEEE Congress on Evolutionary Computation (CEC 2006)*. Piscataway, NJ, USA: IEEE Press, 2006. p. 2630–2637.

[17] NORDIN, P. AIMGP: A formal description. In: KOZA, J. R. (Ed.). *Late Breaking Papers at the Genetic Programming 1998 Conference*. University of Wisconsin, Madison, Wisconsin, USA: Stanford University Bookstore, 1998.

[18] GREEN, N. J. B. *Quantum Mechanics 1: Foundations*. Oxford, UK: Oxford University Press, 1997.

[19] GRIFFITHS, D.; INGLEFIELD, C. *Introduction to electrodynamics*. NJ, USA: Prentice Hall, 1999.

[20] PLANCK, M. On the law of distribution of energy in the normal spectrum. *Annalen der Physik*, v. 4, p. 553, 1901.

[21] GILLESPIE, D. T. *A Quantum Mechanics Primer – An Elementary Introduction to the Formal Theory of Non-Relativistic Quantum Mechanics*. NJ, USA: John Wiley & Sons, 1974.

[22] SPECTOR, L. *Automatic Quantum Computer Programming – A Genetic Programming Approach*. Boston, USA: Springer, 2004. ISBN 1-4020-7894-3.

[23] LAVOR, C.; MANSSUR, L.; PORTUGAL, R. Shor's algorithm for factoring large integers. *Arxiv preprint quant-ph/0303175*, 2003.

[24] RIEFFEL, E.; POLAK, W. An introduction to quantum computing for non-physicists. *ACM Computing Surveys*, v. 32, n. 3, p. 300–335, 2000.

[25] LANYON, B. et al. Quantum computing using shortcuts through higher dimensions. *Arxiv preprint arXiv:0804.0272*, 2008.

[26] MANDEL, O. et al. Controlled collisions for multi-particle entanglement of optically trapped atoms. *Nature*, Nature Publishing Group, v. 425, n. 6961, p. 937–940, 2003.

[27] LEIBFRIED, D. et al. Experimental demonstration of a robust, high-fidelity geometric two ion-qubit phase gate. *Nature*, Nature Publishing Group, v. 422, n. 6930, p. 412–415, 2003.

[28] GASPARONI, S. et al. Realization of a photonic controlled-not gate sufficient for quantum computation. *Physical Review A*, APS, v. 93, n. 2, p. 20504, 2004.

[29] HUGH, D. M.; TWAMLEY, J. Trapped-ion qutrit spin molecule quantum computer. *New Journal of Physics*, v. 7, n. 1, p. 174, 2005. Disponível em: <http://stacks.iop.org/1367-2630/7/i=1/a=174>.

[30] DURT, T. et al. Security of quantum key distribution with entangled qutrits. *Physical Review A*, American Physical Society, v. 67, n. 1, p. 012311, Jan 2003.

[31] KNILL, E. Fault-tolerant postselected quantum computation: Schemes. *Arxiv preprint quant-ph/0402171*, 2004.

[32] MOORE, M.; NARAYANAN, A. Quantum-inspired computing. *Dept. Comput. Sci., Univ. Exeter*, Citeseer, Exeter, UK, 1995.

[33] KNUTH, D. E. *Searching and Sorting*. 2nd. ed. MA, USA: Addison-Wesley Professional, 1998. (The Art of Computer Programming, v. 3).

[34] GARAVAGLIA, S. A quantum-inspired self-organizing map (QISOM). In: *Proceedings of the 2002 International Joint Conference on Neural Networks. IJCNN '02.* Piscataway, NJ, USA: IEEE Press, 2002.

[35] LI, Y.; JIAO, L. Quantum-inspired immune clonal multiobjective optimization algorithm. In: ZHOU, Z.-H.; LI, H.; YANG, Q. (Ed.). *Advances in*

Knowledge Discovery and Data Mining. Berlin, Germany: Springer Berlin / Heidelberg, 2007, (Lecture Notes in Computer Science, v. 4426). p. 672–679.

[36] LEBENSZTAJN, L.; COELHO, L. dos S. A multiobjective gaussian quantum-inspired particle swarm approach applied to electromagnetic optimization. In: *14th Biennial IEEE Conference on Electromagnetic Field Computation (CEFC)*. Chicago, IL, USA: IEEE Press, 2010. p. 1–1. ISBN 978-1-4244-7059-4.

[37] SU, H.; YANG, Y. Quantum-inspired differential evolution for binary optimization. In: *Natural Computation, 2008. ICNC '08. Fourth International Conference on*. Jinan, China: [s.n.], 2008. v. 1, p. 341–346. ISBN 978-0-7695-3304-9.

[38] HAN, K.; KIM, J. Genetic quantum algorithm and its application to combinatorial optimization problem. In: *Proceedings of the 2000 Congress on Evolutionary Computation*. [S.l.: s.n.], 2000. v. 2, p. 1354–1360.

[39] HAN, K.-H. *Quantum-inspired Evolutionary Algorithm*. Tese (Ph.D.) — Korea Advanced Institute of Science and Technology (KAIST), 2003.

[40] JANG, J.-S.; HAN, K.-H.; KIM, J.-H. Face detection using quantum-inspired evolutionary algorithm. In: *Proceedings of Congress on Evolutionary Computation*. [S.l.: s.n.], 2004. v. 2, p. 2100–2106.

[41] KIM, Y.; KIM, J.-H.; HAN, K.-H. Quantum-inspired multiobjective evolutionary algorithm for multiobjective 0/1 knapsack problems. In: *Evolutionary Computation, 2006. CEC 2006. IEEE Congress on*. [S.l.: s.n.], 2006. p. 2601–2606.

[42] TURING, A. M. Intelligent machinery. In: MELTZER, B.; MICHIE, D. (Ed.). *Machine Intelligence*. Edinburgh: Edinburgh University Press, 1948. v. 5.

[43] SAMUEL, A. L. AI, where it has been and where it is going. In: *IJCAI*. [S.l.: s.n.], 1983. p. 1152–1157.

[44] HOLLAND, J. H. *Adaptation in Natural and Artificial Systems*. Ann Arbor: University of Michigan Press, 1975.

[45] WRIGHT, S. Isolation by Distance. *Genetics*, Genetics Society of America, v. 28, n. 2, p. 114, 1943.

[46] TANESE, R. Distributed Genetic Algorithms. In: MORGAN KAUFMANN PUBLISHERS INC. *Proceedings of the Third International Conference on Genetic Algorithms*. [S.l.], 1989. p. 439.

[47] TACKETT, W. *Recombination, selection, and the genetic construction of computer programs*. Tese (Doutorado) — University of Southern California, 1994.

[48] ANDRE, D.; KOZA, J. Parallel genetic programming: A scalable implementation using the transputer network architecture. In: MIT PRESS. *Advances in genetic programming*. [S.l.], 1996. p. 317–337.

[49] POLI, R. *Discovery of Symbolic, Neuro-Symbolic and Neural Networks with Parallel Distributed Genetic Programming*. [S.l.], ago. 1996. Presented at 3rd International Conference on Artificial Neural Networks and Genetic Algorithms, ICANNGA'97.

[50] POLI, R. Parallel distributed genetic programming. In: CORNE, D.; DORIGO, M.; GLOVER, F. (Ed.). *New Ideas in Optimization*. Maidenhead, Berkshire, England: McGraw-Hill, 1999, (Advanced Topics in Computer Science). cap. 27, p. 403–431. ISBN 0-07-709506-5.

[51] BANZHAF, W. Genetic programming for pedestrians. In: FORREST, S. (Ed.). *Proceedings of the Fifth International Conference on Genetic Algorithms (ICGA'93)*. San Mateo, California: Morgan Kaufmann Publishers, 1993. p. 628.

[52] PERKIS, T. Stack-based genetic programming. In: *Proceedings of the 1994 IEEE World Congress on Computational Intelligence*. Orlando, Florida, USA: IEEE Press, 1994. v. 1, p. 148–153.

[53] OPENSHAW, S.; TURTON, I. Building new spatial interaction models using genetic programming. In: FOGARTY, T. C. (Ed.). *Evolutionary Computing*. Leeds, UK: Springer-Verlag, 1994. (Lecture Notes in Computer Science).

[54] NORDIN, P. A compiling genetic programming system that directly manipulates the machine code. In: Kinnear, Jr., K. E. (Ed.). *Advances in Genetic Programming*. [S.l.]: MIT Press, 1994. cap. 14, p. 311–331.

[55] NORDIN, P.; BANZHAF, W.; FRANCONE, F. D. Efficient evolution of machine code for CISC architectures using instruction blocks and homologous crossover. In: SPECTOR, L. et al. (Ed.). *Advances in Genetic*

Programming 3. Cambridge, MA, USA: MIT Press, 1999. cap. 12, p. 275–299.

[56] CREPEAU, R. L. Genetic evolution of machine language software. In: ROSCA, J. P. (Ed.). *Proceedings of the Workshop on Genetic Programming: From Theory to Real-World Applications*. Tahoe, CA, USA: [s.n.], 1995. p. 121–134.

[57] EKLUND, S. E. A massively parallel architecture for linear machine code genetic programming. In: LIU, Y. et al. (Ed.). *Evolvable Systems: From Biology to Hardware: Proceedings of 4th International Conference, ICES 2001*. Tokyo, Japan: Springer-Verlag, 2001. (Lecture Notes in Computer Science, v. 2210), p. 216–224.

[58] DIAS, D. M.; PACHECO, M. A. C.; AMARAL, J. F. M. Genetic programming of a microcontrolled water bath plant. In: GABRYS, B.; HOWLETT, R. J.; JAIN, L. C. (Ed.). *Knowledge-Based Intelligent Information and Engineering Systems, 10th International Conference, KES 2006, Proceedings, Part III*. Bournemouth, UK: Springer, 2006. (Lecture Notes in Computer Science, v. 4253), p. 307–314. ISBN 3-540-46542-1. ISSN 0302-9743.

[59] DIAS, D.; PACHECO, M. Toward a quantum-inspired linear genetic programming model. In: TYRRELL, A. (Ed.). *IEEE Congress on Evolutionary Computation, 2009. CEC '09.* Trondheim, Norway: IEEE Press, 2009. p. 1691–1698.

[60] NORDIN, P. *Evolutionary Program Induction of Binary Machine Code and its Applications*. Tese (Doutorado) — der Universitat Dortmund am Fachereich Informatik, 1997.

[61] INTEL CORPORATION. *Intel Architecture Software Developer's Manual*. [S.l.], 1997.

[62] FOSTER, J. A. Review: Discipulus: A commercial genetic programming system. *Genetic Programming and Evolvable Machines*, v. 2, n. 2, p. 201–203, jun 2001.

[63] BRAMEIER, M.; BANZHAF, W. A comparison of linear genetic programming and neural networks in medical data mining. *IEEE Transactions on Evolutionary Computation*, v. 5, n. 1, p. 17–26, feb 2001.

[64] LANGDON, W. B.; BANZHAF, W. Repeated sequences in linear genetic programming genomes. *Complex Systems*, v. 15, n. 4, p. 285–306, 2005.

[65] LANGDON, W. B.; POLI, R. The halting probability in von Neumann architectures. In: COLLET, P. et al. (Ed.). *Proceedings of the 9th European Conference on Genetic Programming*. Budapest, Hungary: Springer, 2006. (Lecture Notes in Computer Science, v. 3905).

[66] LANGDON, W. B.; POLI, R. Mapping non-conventional extensions of genetic programming. *Natural Computing*, v. 7, p. 21–43, mar 2008. Invited contribution to special issue on Unconventional computing.

[67] LUKSCHANDL, E. et al. Distributed java bytecode genetic programming. In: POLI, R. et al. (Ed.). *Genetic Programming, Proceedings of EuroGP'2000*. Edinburgh: Springer-Verlag, 2000. (LNCS, v. 1802), p. 316–325.

[68] BANZHAF, W.; FRANCONE, F. D.; NORDIN, P. The effect of extensive use of the mutation operator on generalization in genetic programming using sparse data sets. In: VOIGT, H.-M. et al. (Ed.). *Parallel Problem Solving from Nature IV, Proceedings of the International Conference on Evolutionary Computation"*. Berlin, Germany: Springer Verlag, 1996. (Lecture Notes in Computer Science, v. 1141), p. 300–309.

[69] FRANCONE, F. D. *Discipulus Users Manual, Version 3.0*. [S.l.], 2004.

[70] DERMEZ, R.; ÖZEN, S. Higher dimensional entangled qudits in a trapped three-level ion. *The European Physical Journal D - Atomic, Molecular, Optical and Plasma Physics*, Springer, Berlin, Heidelberg, Germany, v. 57, p. 431–437, 2010.

[71] NORDIN, P. et al. AIM-GP and parallelism. In: *Evolutionary Computation, 1999. CEC 99. Proceedings of the 1999 Congress on*. [S.l.: s.n.], 1999. v. 2.

[72] KORDON, A. *Symbolic Regression Competition – EvoStar Conference*. 2010. `http://casnew.iti.upv.es/index.php/evocompetitions/105-symregcompetition`. Dow Chemical (USA).

[73] SINGULANI, A. et al. Computational intelligence applied to the growth of quantum dots. *Journal of Crystal Growth*, Elsevier Science Publishing Co, Inc, P.O. Box 882, Madison Square Station, New York, NY, 10159-0882, USA, v. 310, n. 23, p. 5063–5065, 2008.

[74] VILELA NETO, O. P. *Projeto, Otimização, Simulação e Predição de Propriedades de Nanoestruturas Através de Técnicas da Inteligência*

Computacional: Nanotecnologia Computacional Inteligente. Tese (Doutorado) — PUC-Rio, 2009.

[75] BLAKE, C. L.; MERZ, C. J. *UCI Repository of Machine Learning Databases*. 1998. `http://www.ics.uci.edu/~mlearn/MLRepository.html`.

[76] CORDER, G.; FOREMAN, D. *Nonparametric statistics for non-statisticians: A step-by-step approach*. [S.l.]: John Wiley & Sons Inc, 2009.

[77] MCBREWSTER, J.; MILLER, F. P.; VANDOME, A. F. *Parallel Computing: Computing, High-performance computing, Instruction level parallelism, Data parallelism, Task parallelism, Multi-core, Symmetric multiprocessing, ... parallel processing, GPGPU, Grid computing*. [S.l.]: Alpha Press, 2009. ISBN 6130029411, 9786130029418.

[78] BANZHAF, W.; HARDING, S. Accelerating evolutionary computation with graphics processing units. In: *GECCO '09: Proceedings of the 11th annual conference companion on Genetic and evolutionary computation conference*. New York, NY, USA: ACM, 2009. p. 3237–3286. ISBN 978-1-60558-505-5.

[79] WILSON, G.; HARDING, S. WCCI 2008 special session: Computational intelligence on consumer games and graphics hardware (CIGPU-2008). *SIGEvolution*, v. 3, n. 1, p. 19–21, 2008. Disponível em: <http://www.sigevolution.org/issues/pdf/SIGEVOlution200801.pdf>.

[80] WILSON, G.; BANZHAF, W. Deployment of parallel linear genetic programming using GPUs on PC and video game console platforms. *Genetic Programming and Evolvable Machines*, v. 11, n. 2, p. 147–184, junho 2010. ISSN 1389-2576.

A
Código dos Melhores Programas Evoluídos

As figuras A.1 a A.4 mostram, em linguagem de montagem, os melhores programas evoluídos por ambos os modelos, para os estudos de caso "Distância Euclideana" e "Chapéu Mexicano", onde as linhas de código estão numeradas pela ordem de execução. Nas figuras A.1 e A.2, $V[0]$ a $V[5]$ representam as 6 variáveis de entrada, enquanto que $V[i]\ \forall\ i > 5$, as 9 constantes. Nas figuras A.3 e A.4, $V[0]$ e $V[1]$ representam as 2 variáveis de entrada, enquanto $V[i]\ \forall\ i > 2$, as 9 constantes.

```
1  FMUL  ST(0),ST(0)
2  FSUB  ST(6),ST(0)
3  FSQRT
4  FADD  ST(2),ST(0)
5  FADD  V[3]
6  FSUB  ST(2),ST(0)
7  FMUL  ST(0),ST(4)
8  FADD  V[5]
9  FSUB  V[2]
10 FMUL  ST(0),ST(0)
11 FSUB  ST(6),ST(0)
12 FMUL  ST(0),ST(4)
13 FABS
14 FADD  V[1]
15 FADD  ST(7),ST(0)
16 FMUL  ST(0),ST(5)
17 FXCH  ST(4)
18 FADD  V[3]
19 FMUL  ST(3),ST(0)
20 FSQRT
21 FSUB  ST(0),ST(1)
22 FADD  ST(0),ST(3)
23 FXCH  ST(7)
24 FSUB  V[4]
25 FSUB  ST(4),ST(0)
26 FMUL  ST(0),ST(0)
27 FXCH  ST(2)
28 FABS
29 FSUB  V[0]
30 FMUL  ST(0),ST(0)
31 FMUL  ST(5),ST(0)
32 FADD  ST(2),ST(0)
33 FSUB  ST(0),ST(0)
34 FADD  ST(3),ST(0)
35 FMUL  ST(0),ST(1)
36 FSUB  ST(3),ST(0)
37 FSUB  V[5]
38 FMUL  ST(0),ST(0)
39 FSUB  ST(7),ST(0)
40 FSQRT
41 FADD  ST(4),ST(0)
42 FABS
43 FMUL  ST(4),ST(0)
44 FSUB  ST(0),ST(1)
45 FSUB  ST(0),ST(0)
46 FSUB  ST(6),ST(0)
47 FADD  ST(0),ST(6)
48 FSUB  V[12]
49 FABS
50 FADD  V[9]
51 FMUL  ST(0),ST(0)
52 FADD  V[0]
53 FADD  ST(5),ST(0)
54 FABS
55 FADD  ST(5),ST(0)
56 FXCH  ST(0)
57 FADD  ST(5),ST(0)
58 FSUB  ST(3),ST(0)
59 FMUL  V[11]
60 FMUL  ST(0),ST(0)
61 FMUL  ST(0),ST(3)
62 FMUL  ST(0),ST(5)
63 FABS
64 FXCH  ST(7)
65 FABS
66 FSQRT
67 FMUL  ST(0),ST(3)
68 FSUB  ST(6),ST(0)
69 FSUB  ST(2),ST(0)
70 FSUB  ST(0),ST(6)
71 FADD  ST(3),ST(0)
72 FSUB  ST(0),ST(0)
73 FXCH  ST(1)
74 FADD  ST(5),ST(0)
75 FSUB  ST(7),ST(0)
76 FABS
77 FXCH  ST(4)
78 FMUL  ST(0),ST(7)
79 FADD  ST(0),ST(0)
80 FABS
81 FSUB  ST(0),ST(7)
82 FSUB  ST(2),ST(0)
83 FSUB  ST(0),ST(6)
84 FADD  ST(3),ST(0)
85 FADD  ST(0),ST(2)
86 FADD  ST(5),ST(0)
87 FABS
88 FSUB  ST(4),ST(0)
89 FMUL  ST(6),ST(0)
90 FSQRT
91 FADD  ST(1),ST(0)
```

Figura A.1: Melhor programa evoluído pelo modelo AIMGP para o estudo de caso "Distância Euclideana".

```
1  FABS
2  FMUL  V[5]
3  FSUB  ST(0),ST(3)
4  FADD  ST(0),ST(2)
5  FSUB  V[0]
6  FADD  V[3]
7  FABS
8  FADD  ST(2),ST(0)
9  FSUB  ST(7),ST(0)
10 FXCH  ST(4)
11 FSUB  V[5]
12 FADD  V[2]
13 FMUL  ST(0),ST(0)
14 FXCH  ST(4)
15 FMUL  ST(0),ST(7)
16 FADD  ST(2),ST(0)
17 FXCH  ST(0)
18 FMUL  ST(7),ST(0)
19 FSUB  ST(4),ST(0)
20 FABS
21 FADD  V[6]
22 FADD  ST(0),ST(5)
23 FADD  V[1]
24 FXCH  ST(7)
25 FADD  ST(0),ST(3)
26 FMUL  ST(0),ST(4)
27 FSUB  ST(0),ST(2)
28 FSUB  ST(0),ST(1)
29 FMUL  V[3]
30 FMUL  ST(0),ST(2)
31 FADD  ST(0),ST(6)
32 FMUL  ST(7),ST(0)
33 FMUL  ST(0),ST(2)
34 FMUL  ST(0),ST(0)
35 FMUL  ST(5),ST(0)
36 FSUB  ST(1),ST(0)
37 FMUL  ST(0),ST(1)
38 FXCH  ST(2)
39 FSUB  ST(0),ST(0)
40 FSUB  ST(0),ST(0)
41 FADD  V[1]
42 FMUL  ST(3),ST(0)
43 FSUB  ST(0),ST(2)
44 FABS
45 FABS
46 FSUB  V[4]
47 FMUL  ST(0),ST(0)
48 FADD  ST(0),ST(4)
49 FSQRT
```

Figura A.2: Melhor programa evoluído pelo modelo PGLIQ para o estudo de caso "Distância Euclideana".

```
1  FADD  ST(1),ST(0)
2  FMUL  ST(0),ST(4)
3  FADD  ST(0),ST(4)
4  FCOS
5  FCOS
6  FMUL  V[1]
7  FCOS
8  FSIN
9  FDIV  V[10]
10 FSUB  ST(7),ST(0)
11 FXCH  ST(1)
12 FADD  V[0]
13 FMUL  ST(4),ST(0)
14 FSIN
15 FCOS
16 FCOS
17 FMUL  ST(4),ST(0)
18 FDIV  ST(7),ST(0)
19 FSUB  ST(0),ST(6)
20 FABS
21 FDIV  ST(7),ST(0)
22 FXCH  ST(3)
23 FMUL  ST(2),ST(0)
24 FXCH  ST(4)
25 FXCH  ST(0)
26 FADD  ST(0),ST(3)
27 FMUL  ST(5),ST(0)
28 FMUL  ST(0),ST(3)
29 FSIN
30 FMUL  V[1]
31 FCOS
32 FADD  ST(0),ST(7)
33 FABS
34 FADD  ST(7),ST(0)
35 FADD  ST(0),ST(1)
36 FDIV  ST(0),ST(3)
37 FSUB  ST(3),ST(0)
38 FCOS
39 FSIN
40 FSIN
41 FSUB  ST(0),ST(1)
42 FADD  ST(0),ST(7)
43 FDIV  V[9]
44 FSQRT
45 FMUL  V[0]
46 FSIN
47 FADD  ST(2),ST(0)
48 FMUL  ST(5),ST(0)
49 FADD  ST(2),ST(0)
50 FCOS
51 FMUL  V[1]
52 FCOS
53 FDIV  V[10]
54 FADD  ST(1),ST(0)
55 FSUB  ST(6),ST(0)
56 FSUB  ST(0),ST(6)
57 FCOS
58 FDIV  ST(2),ST(0)
59 FXCH  ST(2)
60 FCOS
61 FABS
62 FSUB  ST(0),ST(5)
63 FDIV  ST(0),ST(2)
64 FMUL  ST(6),ST(0)
65 FABS
66 FDIV  ST(0),ST(2)
67 FMUL  ST(0),ST(0)
68 FADD  V[7]
69 FCOS
70 FDIV  ST(6),ST(0)
71 FSUB  ST(0),ST(6)
72 FSIN
73 FCOS
74 FCOS
75 FDIV  V[9]
76 FMUL  V[0]
77 FMUL  V[0]
78 FSIN
79 FDIV  V[4]
80 FXCH  ST(3)
81 FXCH  ST(1)
82 FSUB  ST(0),ST(3)
83 FSUB  ST(3),ST(0)
84 FSUB  ST(0),ST(3)
85 FSUB  ST(3),ST(0)
86 FDIV  ST(0),ST(2)
87 FSIN
88 FMUL  ST(0),ST(3)
89 FABS
90 FSUB  ST(0),ST(3)
91 FSUB  ST(3),ST(0)
92 FSUB  ST(0),ST(6)
93 FMUL  ST(0),ST(2)
```

Figura A.3: Melhor programa evoluído pelo modelo AIMGP para o estudo de caso "Chapéu Mexicano".

```
1  FADD  V[4]
2  FMUL  ST(0),ST(0)
3  FMUL  ST(0),ST(0)
4  FMUL  ST(0),ST(0)
5  FMUL  V[3]
6  FMUL  ST(0),ST(0)
7  FMUL  ST(0),ST(0)
8  FMUL  ST(0),ST(0)
9  FMUL  V[1]
10 FMUL  ST(0),ST(0)
11 FMUL  ST(0),ST(0)
12 FMUL  ST(0),ST(0)
13 FMUL  V[0]
14 FMUL  ST(0),ST(0)
15 FSUB  ST(6),ST(0)
16 FMUL  ST(0),ST(0)
17 FMUL  ST(0),ST(0)
18 FSQRT
19 FMUL  ST(0),ST(0)
20 FSQRT
21 FMUL  ST(0),ST(0)
22 FMUL  V[0]
23 FMUL  ST(0),ST(0)
24 FSUB  ST(4),ST(0)
25 FADD  V[0]
26 FADD  ST(0),ST(4)
27 FADD  ST(0),ST(0)
28 FXCH  ST(3)
29 FADD  V[1]
30 FSUB  V[0]
31 FXCH  ST(5)
32 FSUB  ST(1),ST(0)
33 FMUL  ST(0),ST(0)
34 FXCH  ST(3)
35 FADD  ST(0),ST(1)
36 FMUL  ST(0),ST(0)
37 FMUL  ST(0),ST(0)
38 FMUL  ST(0),ST(0)
39 FMUL  V[6]
40 FMUL  ST(0),ST(0)
41 FSUB  ST(5),ST(0)
42 FADD  ST(0),ST(0)
43 FSQRT
44 FADD  V[2]
45 FMUL  ST(4),ST(0)
46 FSQRT
47 FSUB  ST(0),ST(4)
48 FMUL  ST(0),ST(0)
49 FADD  ST(0),ST(6)
50 FADD  ST(0),ST(6)
51 FADD  ST(0),ST(5)
52 FXCH  ST(9)
53 FSUB  V[2]
54 FXCH  ST(4)
```

Figura A.4: Melhor programa evoluído pelo modelo PGLIQ para o estudo de caso "Chapéu Mexicano".