



Computação Evolucionária

O Dilema dos Prisoneiros

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Agenda

- Contexto
- Desenvolvimento
- Diagrama de Classe (UML)
- Ferramentas Utilizadas
- Configurações do Algoritmo Genético
- Resultados
- Conclusão
- Agradecimentos

Contexto

- Tem-se o seguinte contexto neste trabalho.
 - Duas pessoas cometeram um crime. Elas são presas. Para que o governo consiga prendê-los, ele precisa que elas confessem e mostrem provas sobre o crime. Elas são interrogadas separadas.
 - Se as duas pessoas não confessarem (isto é, cooperarem entre si), então o governo terá de soltá-los em 6 meses devido à falta de provas.

Contexto

- No entanto, se uma delas ficar calada e a outra confessar, a pessoa que cooperou com o parceiro de crime (ficou calado) vai ser preso por 30 anos, enquanto o outro que confessou, por ter ajudado a polícia, será solto na hora.
- Se ambos confessarem, então ambos são presos por 10 anos por terem cooperado com a justiça.

Desenvolvimento

- Cada indivíduo é uma cadeia de números reais entre 0 e 1, onde 0 é máxima cooperação com o parceiro e 1 é a máxima delação do parceiro.
- Ou seja, abaixo de 0,5 é cooperação (não delação) e acima de 0,5 é delação.
- Cada cromossomo possui 30 genes.
- Existem 2 tipos de *Fitness*, um individual e outro em grupo.

Desenvolvimento

- Esta implementação utiliza duas parcelas em cada um dos fitness, a primeira segue as tabelas abaixo.

Tabela: Fitness Individual

Condição	Valor do Fitness
DC	1
CC	0.9
DD	0.66
CD	0

Tabela: Fitness em Grupo

Condição	Valor do Fitness
CC	1
CD ou DC	0.33
DD	0

C = Coopera , **D** = Delata

D = 0 anos, **C** = 30 anos , **CC** = 6 meses, **DD** = 10 Anos

Desenvolvimento

- A segunda parcela é calculada através de quantidade de cadeias de Cooperações que o indivíduo possua, da qual é extraída uma média e aplica-se um bônus sobre ela através da seguinte fórmula:

$$Bonus = (numcadeias * valbonus) * (1 - mediagenes_c)$$

Diagrama de Classes (UML)

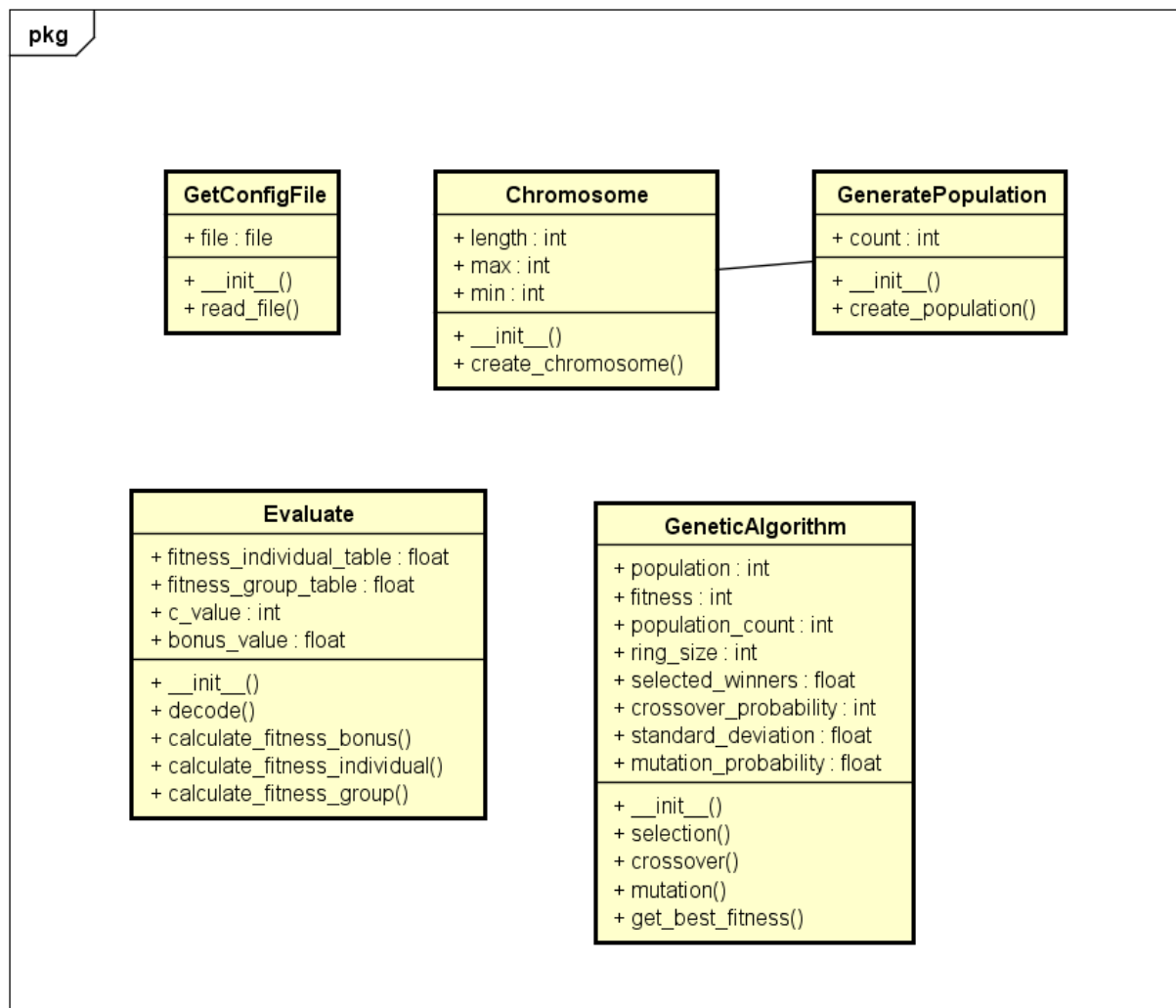


Diagrama de Classe (UML)

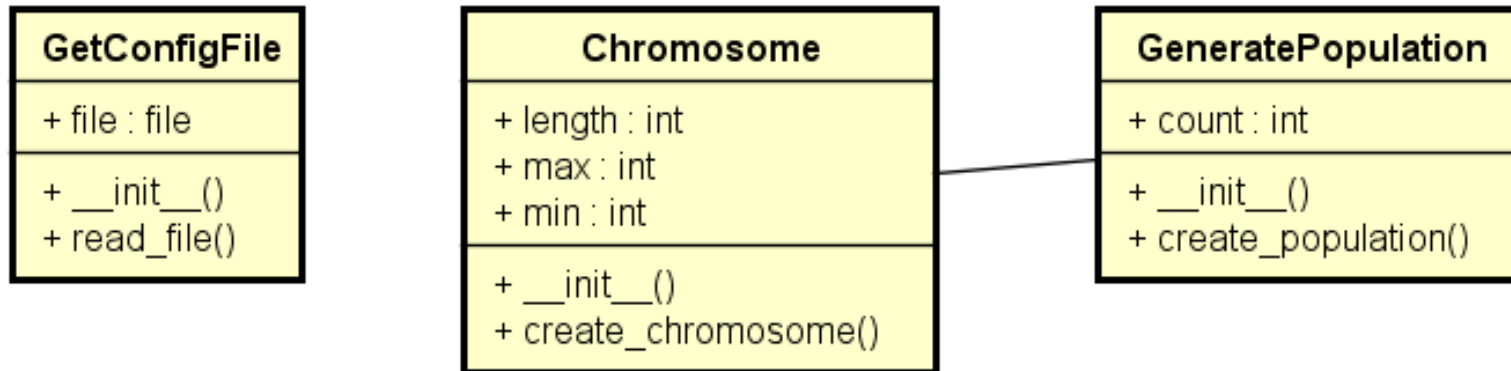
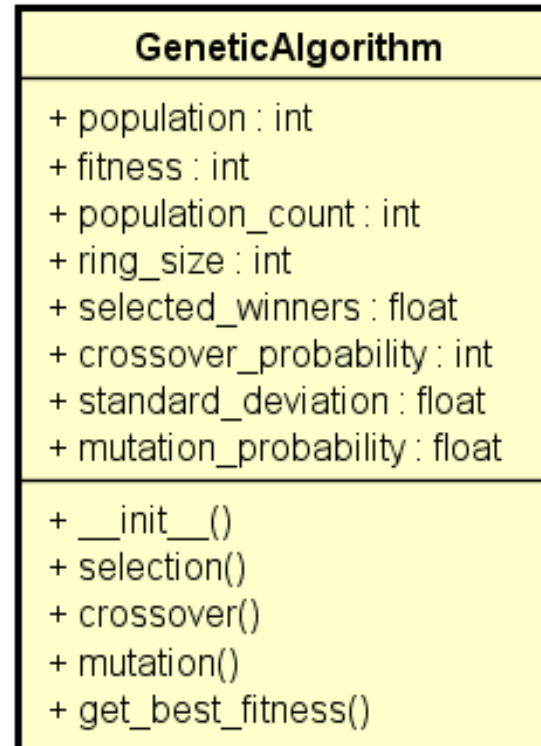
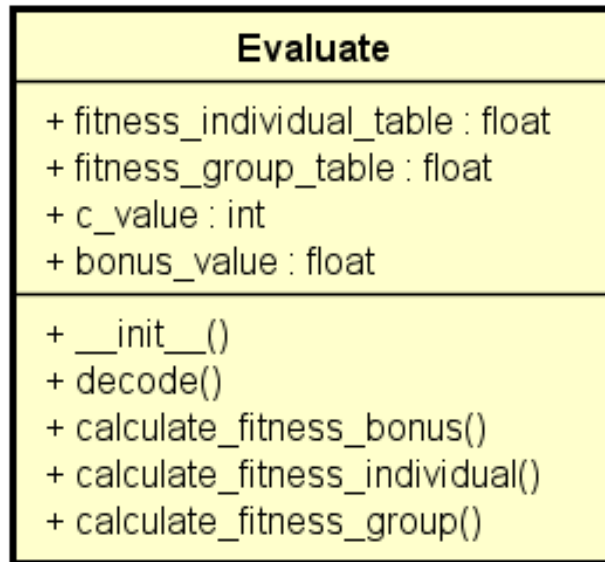


Diagrama de Classe (UML)



Ferramentas Utilizadas

- **Sistema Operacional:** Windows 8
- **Linguagem de Programação:** Python (v3.6)
- **IDE:** PyCharm 2017 1.3
- **Controle de Versão:** Git
- **Repositório:** Bitbucket

Configurações do Algoritmo Genético

	Caso de Teste 1		Caso de Teste 2		Caso de Teste 3	
Parâmetro	Individual	Grupo	Individual	Grupo	Individual	Grupo
Tamanho da População	50	50	50	50	50	50
Tamanho do Ring	3	3	3	3	3	3
Prob. de Cruzamento	90%	90%	90%	90%	90%	90%
Prob. de Mutação	1%	1%	1%	1%	1%	1%
Desvio-Padrão	1%	1%	1%	1%	1%	1%
Gerações	600	600	1200	1200	1200	1200
Valor de C	10/20	10/20	10/20	10/20	10/20	10/20
Valor do Bônus	0%/20%/40%	0%/20%/40%	0%/20%/40%	0%/20%/40%	0%/20%/40%	0%/20%/40%

Método de Seleção: Torneio

Tipo de Cruzamento: Aritmético

Tipo de Mutação: Gaussiana

Caso de Teste 1: Par-a-Par

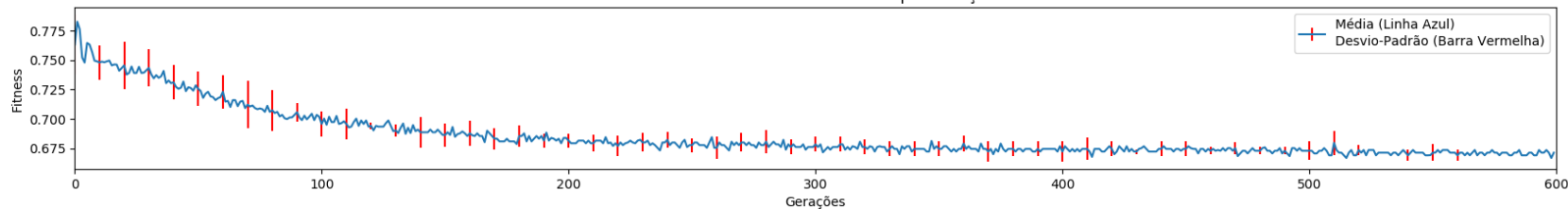
Caso de Teste 2: 10% de Opositores

Caso de Teste 3: 30% de Opositores

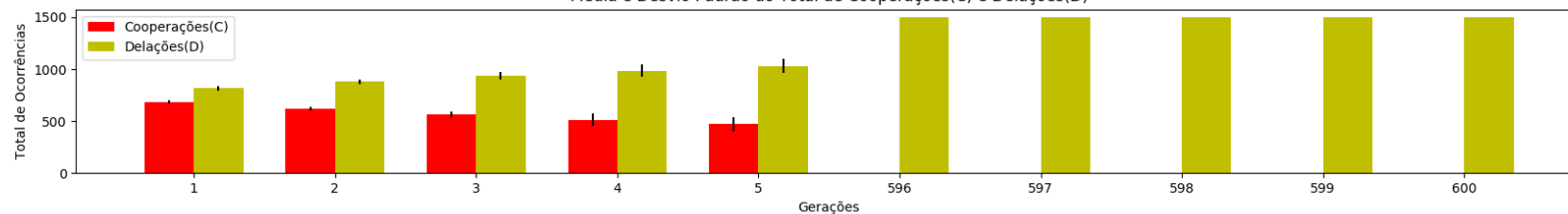
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Caso de Teste = Par-a-par, Fitness = Individual, Valor de C = 10, Bônus = 0.0 %

Média e Desvio Padrão do Fitness por Geração

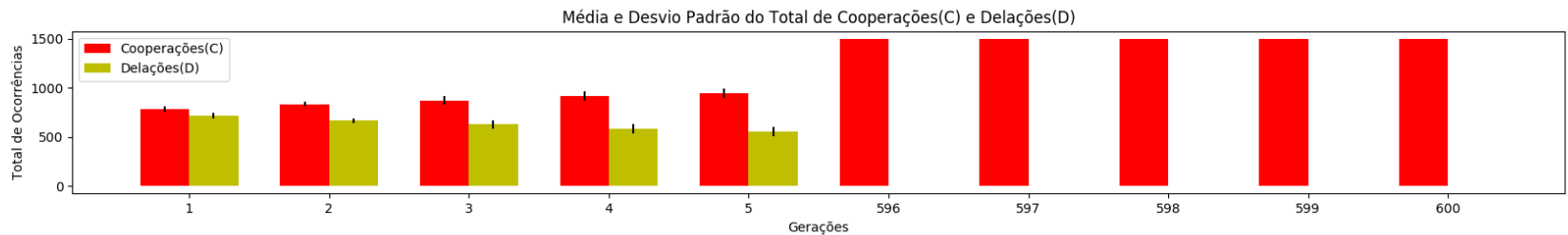
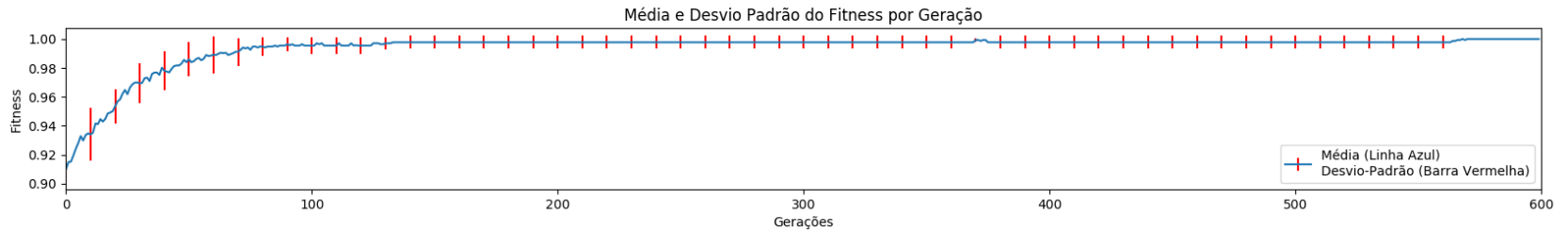


Média e Desvio Padrão do Total de Cooperações(C) e Delações(D)

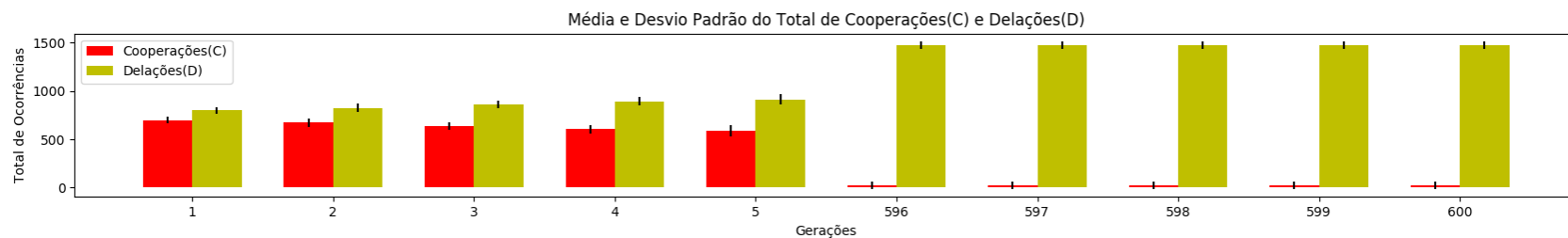
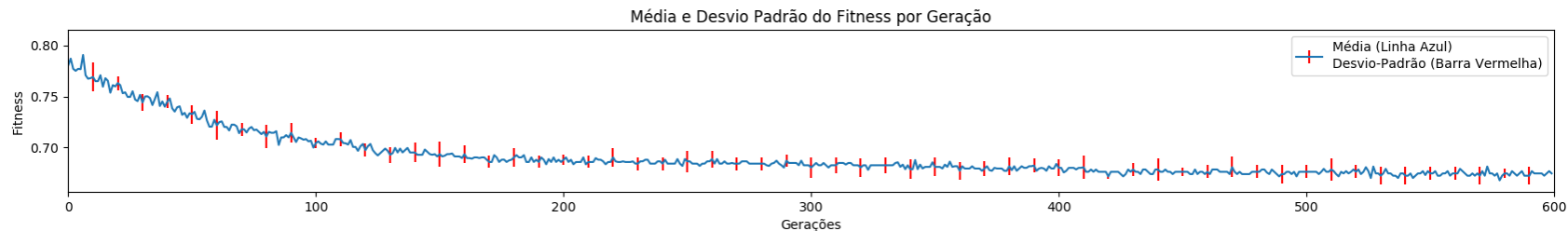
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Caso de Teste = Par-a-par, Fitness = Grupo, Valor de C = 10, Bônus = 0.0 %

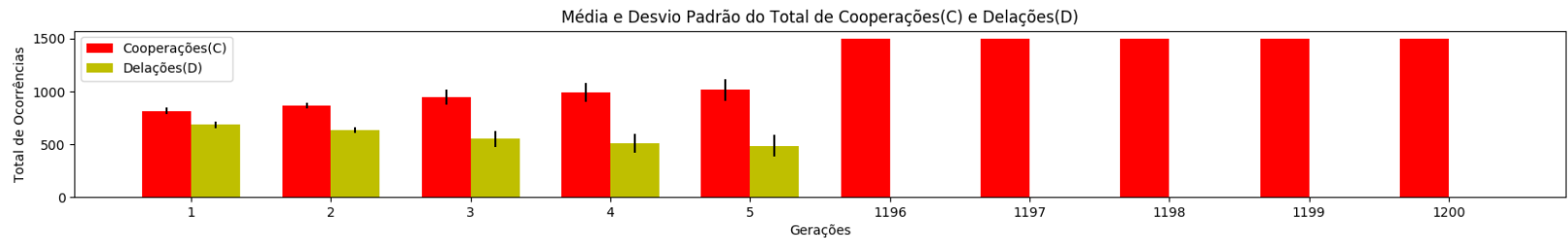
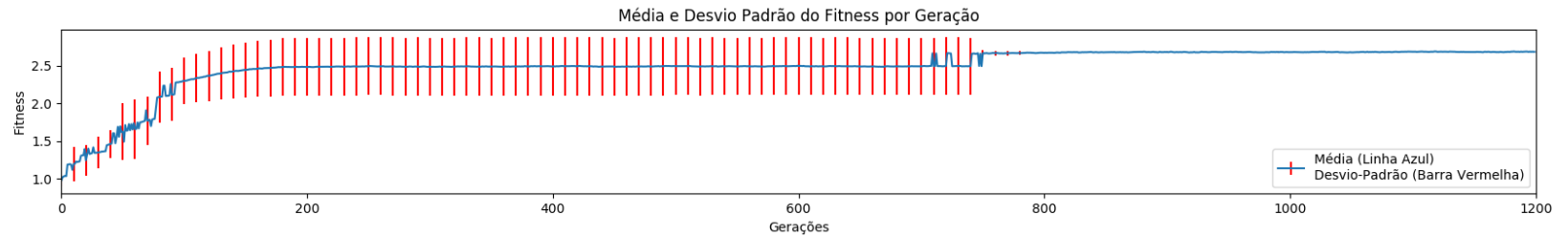
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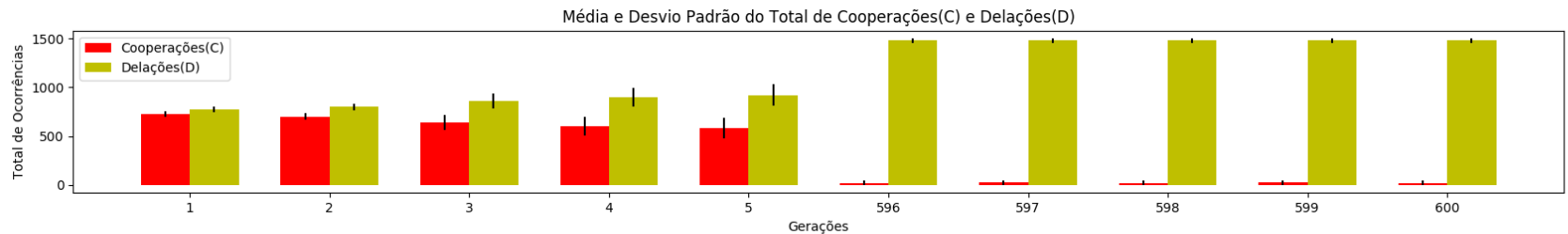
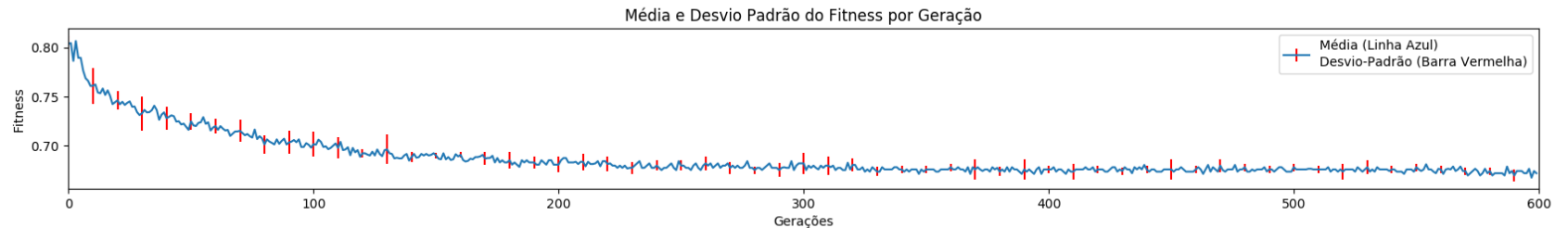
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Caso de Teste = Par-a-par, Fitness = Grupo, Valor de C = 10, Bônus = 20.0 %

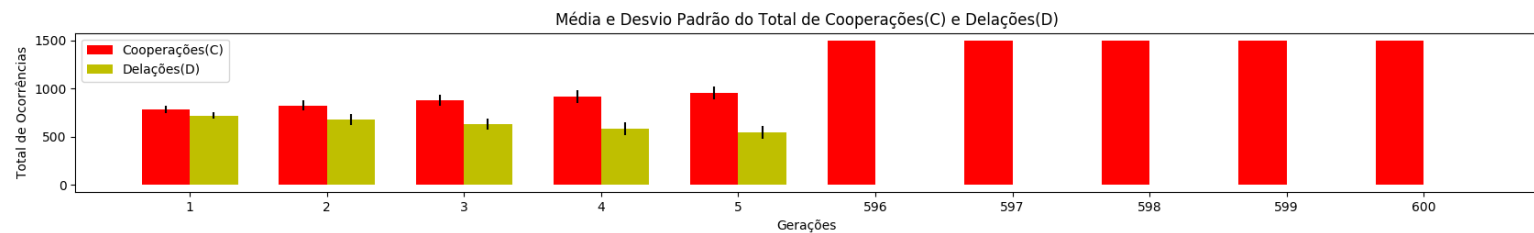
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Caso de Teste = Par-a-par, Fitness = Individual, Valor de C = 20, Bônus = 20.0 %



	Melhor Indivíduo
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2	D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,C,D,D,D,D,D,D
3	D,D
4	D,D
5	D,D

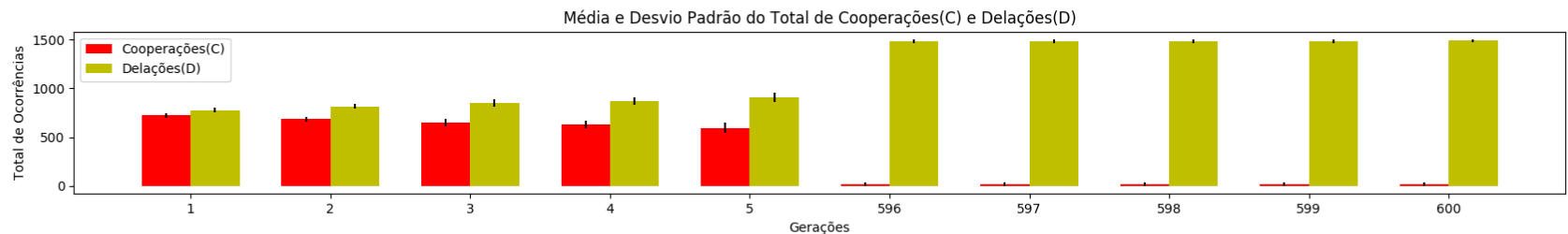
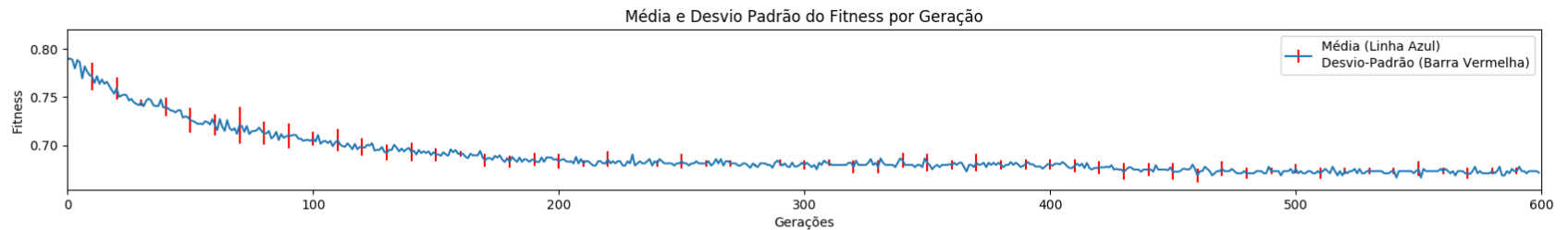
18



	Melhor Indivíduo
1	C,C
2	C,C
3	C,C
4	C,C
5	C,C

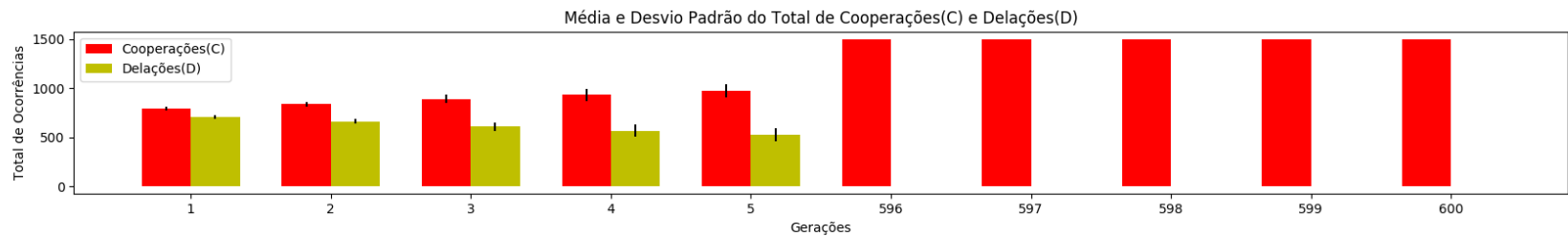
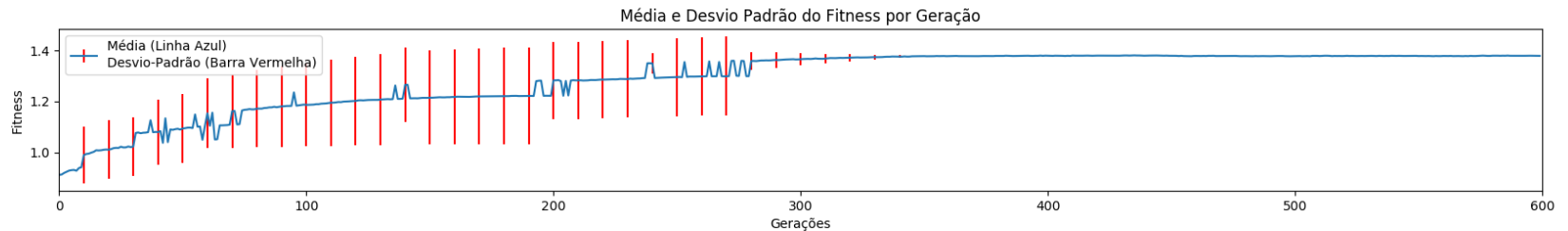
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Caso de Teste = Par-a-par, Fitness = Individual, Valor de C = 20, Bônus = 40.0 %

[illegible]

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Caso de Teste = Par-a-par, Fitness = Grupo, Valor de C = 20, Bônus = 40.0 %



	Melhor Indivíduo
1	C,C
2	C,C
3	C,C
4	C,C
5	C,C

21

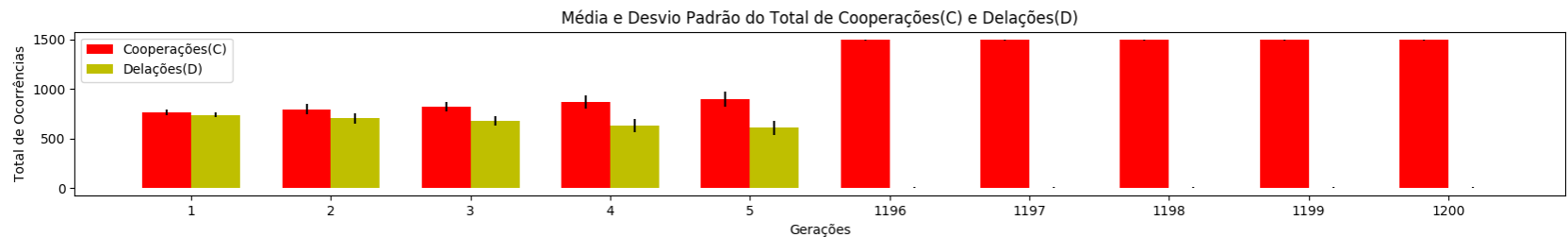
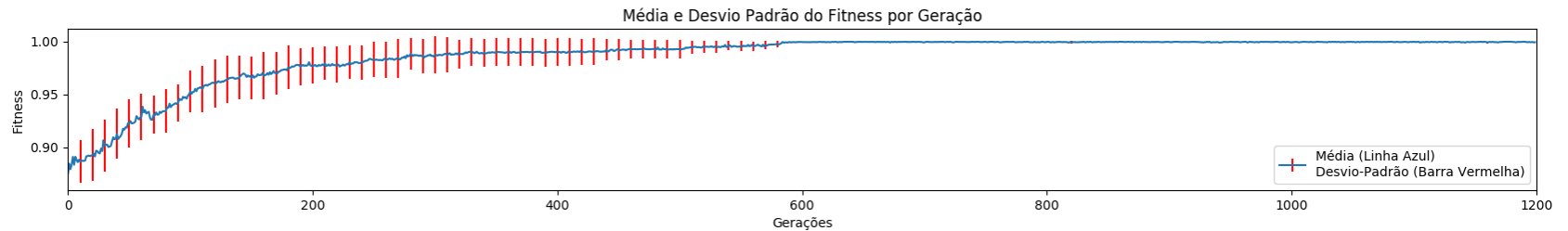
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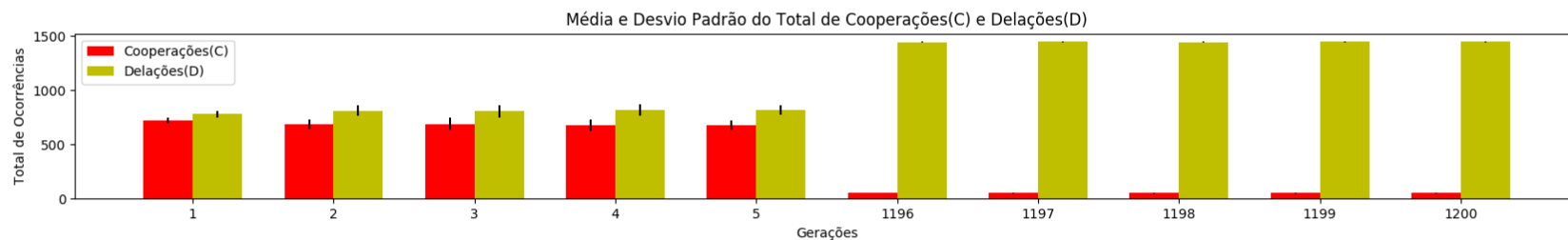
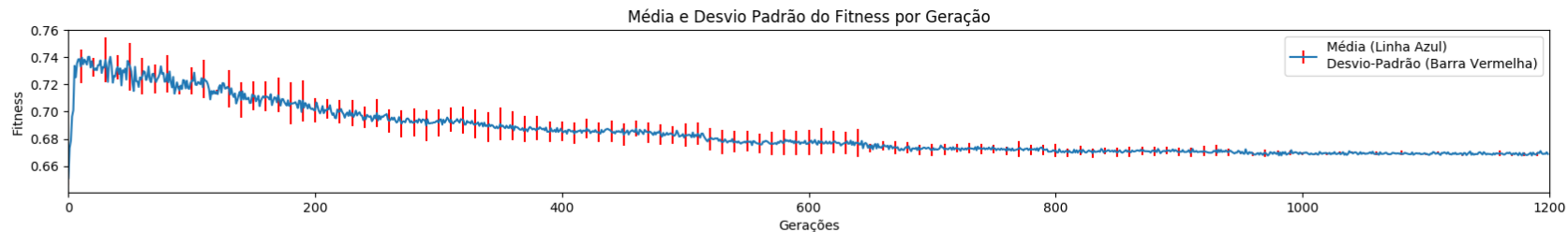
Caso de Teste = 10.0 % de Opositores, Fitness = Grupo, Valor de C = 10, Bônus = 0.0 %



	Melhor Indivíduo
1	C,C
2	C,C
3	C,C
4	C,C
5	C,C

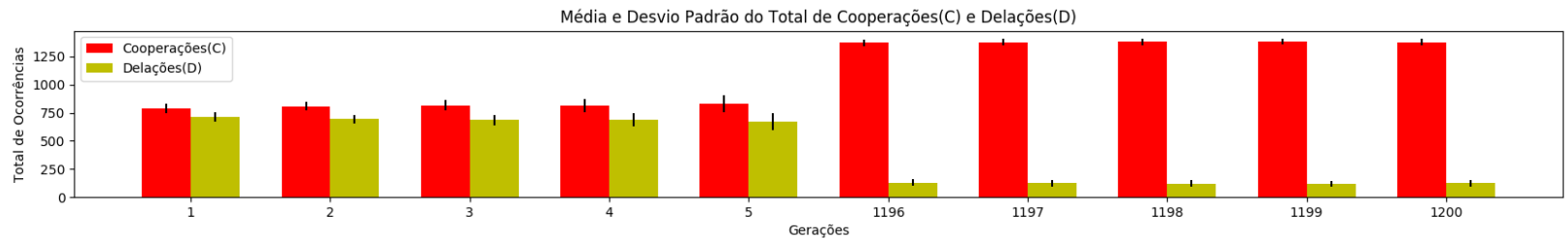
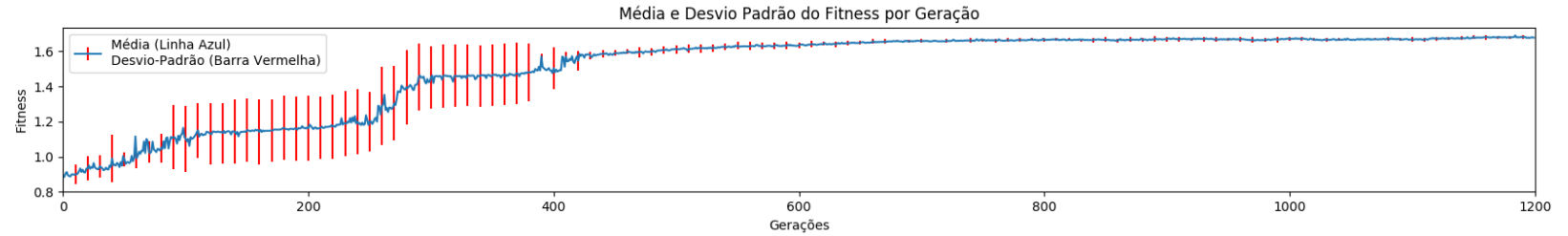
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Caso de Teste = 10.0 % de Opositores, Fitness = Individual, Valor de C = 10, Bônus = 20.0 %



	Melhor Indivíduo
1	D,D,D,C,D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,D
2	C,D
3	D,C,D
4	D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,C,D,D,D
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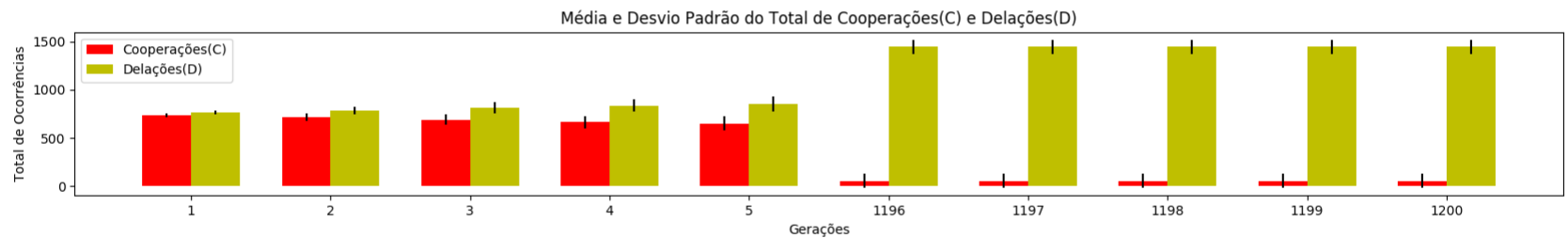
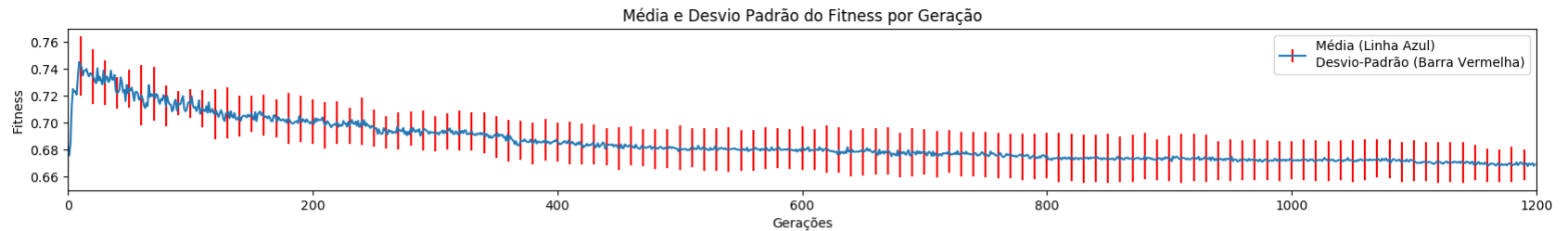
Caso de Teste = 10.0 % de Opositores, Fitness = Grupo, Valor de C = 10, Bônus = 20.0 %



	Melhor Indivíduo
1	C,C,C,C,C,C,C,C,C,D,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C
2	D,C,C,C,C,C,C,D,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C
3	C,C
4	D,C,D,C
5	C,C,C,C,C,C,D,D,C

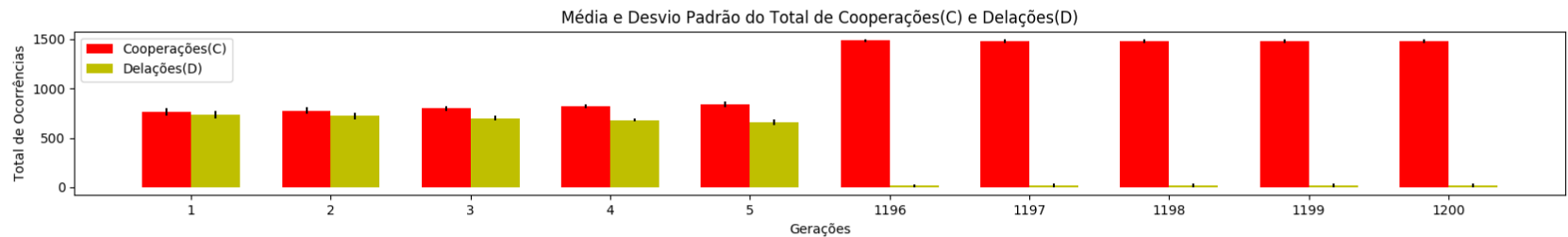
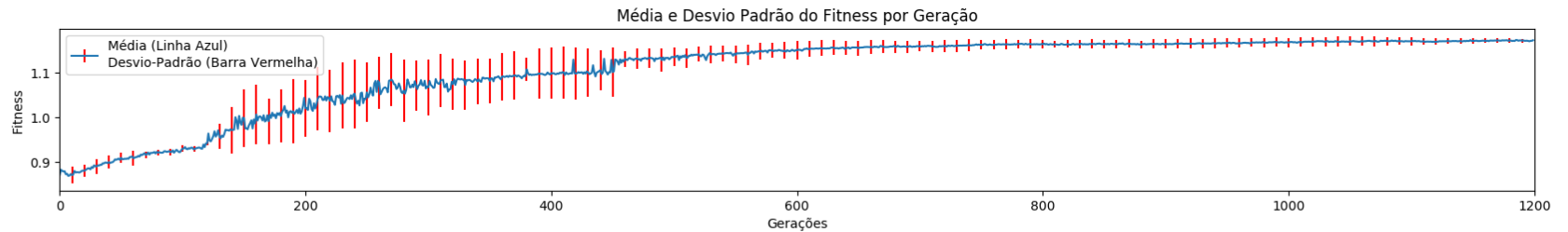
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Caso de Teste = 10.0 % de Opositores, Fitness = Individual, Valor de C = 20, Bônus = 20.0 %

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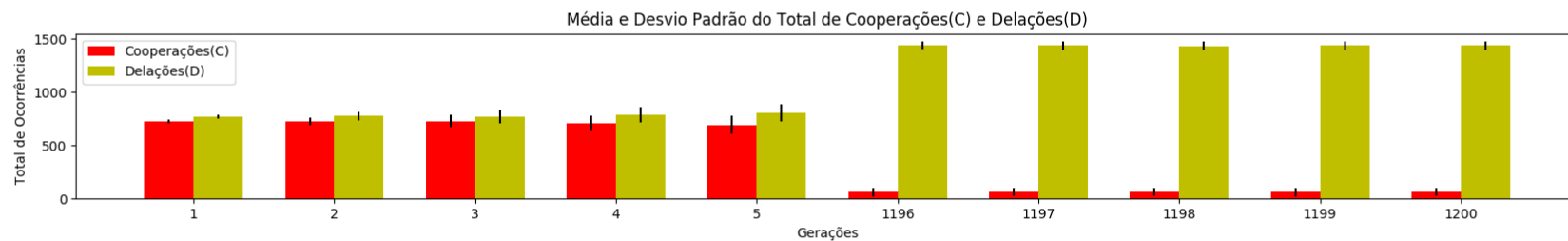
Caso de Teste = 10.0 % de Opositores, Fitness = Grupo, Valor de C = 20, Bônus = 20.0 %



	Melhor Indivíduo
1	C,C
2	C,C
3	C,C
4	C,C
5	C,C,C,C,D,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C

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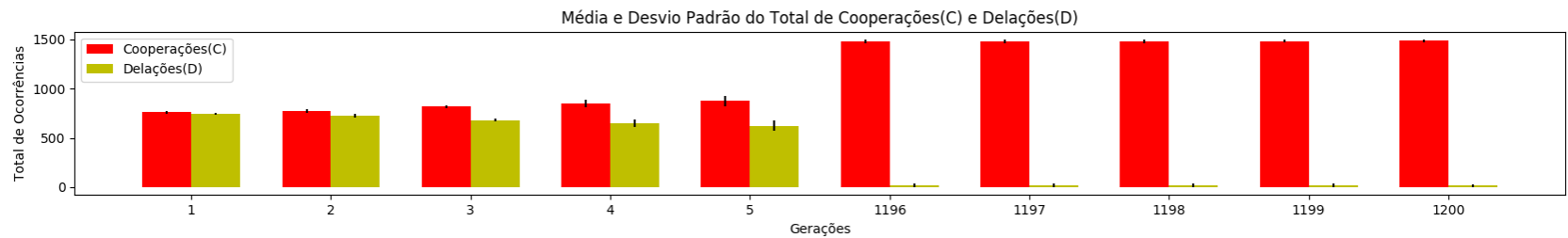
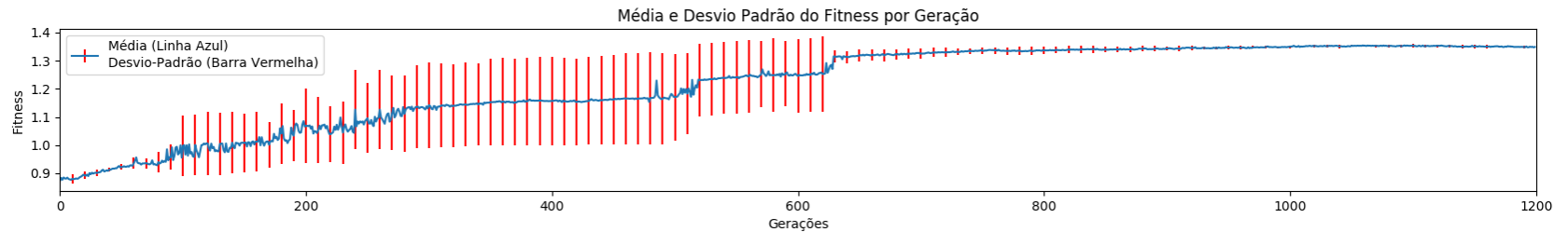
Caso de Teste = 10.0 % de Opositores, Fitness = Individual, Valor de C = 20, Bônus = 40.0 %



	Melhor Indivíduo
1	D,D
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3	D,D,D,D,D,D,D,D,D,C,D,D,D,D,D,D,D,D,D,D,D,D
4	D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,D,C,D,D,D,C,D,D
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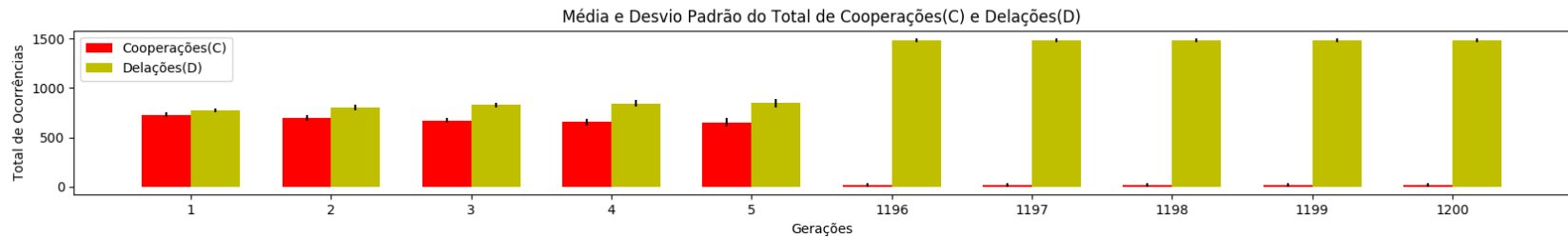
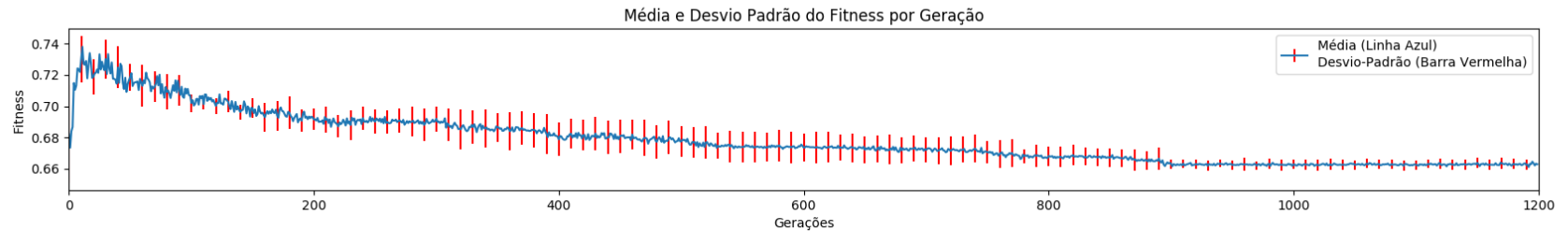
Caso de Teste = 10.0 % de Opositores, Fitness = Grupo, Valor de C = 20, Bônus = 40.0 %



	Melhor Indivíduo
1	C,C
2	C,C
3	C,C
4	C,C
5	C,C,C,C,D,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C

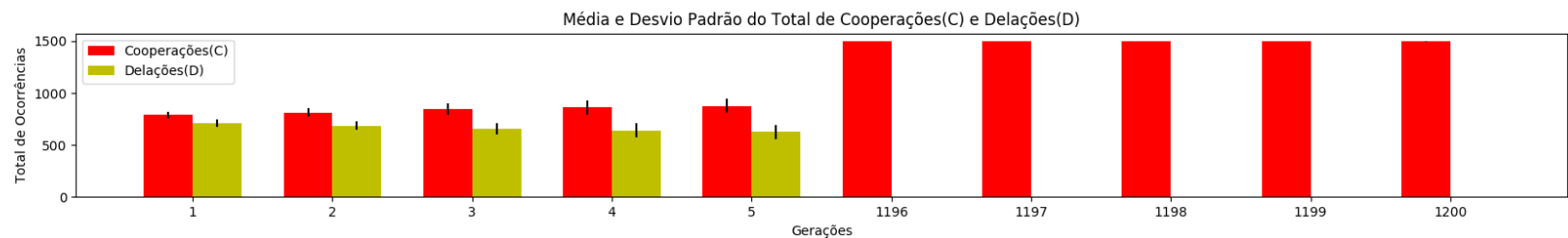
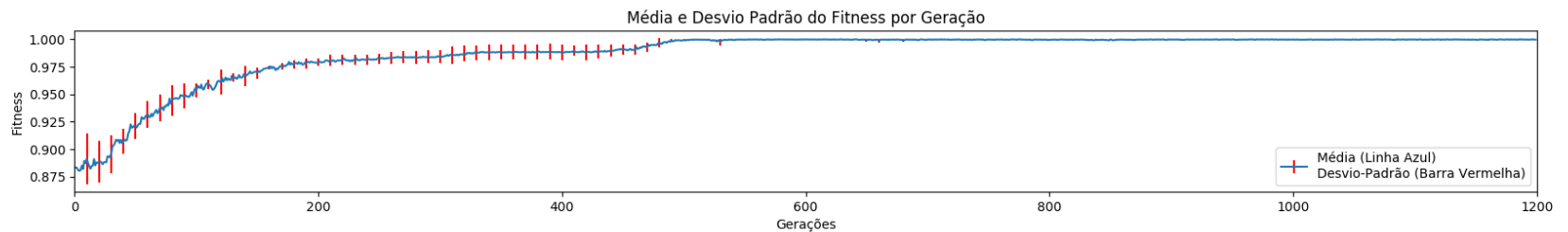
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Caso de Teste = 30.0 % de Opositores, Fitness = Individual, Valor de C = 10, Bônus = 0.0 %

[illegible]

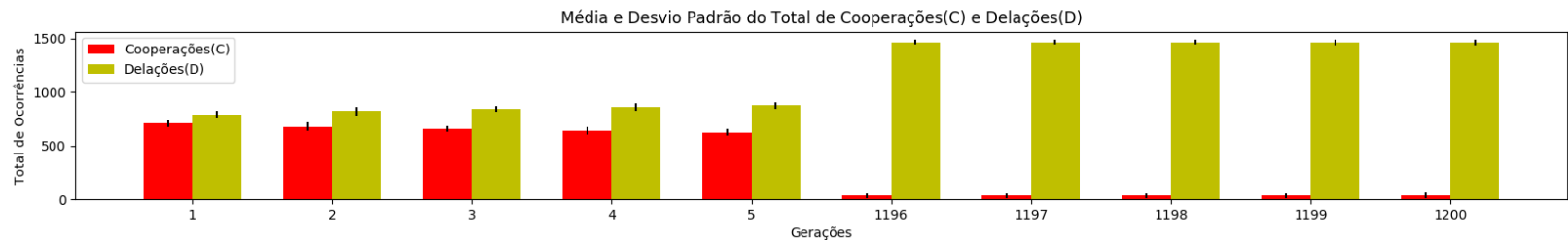
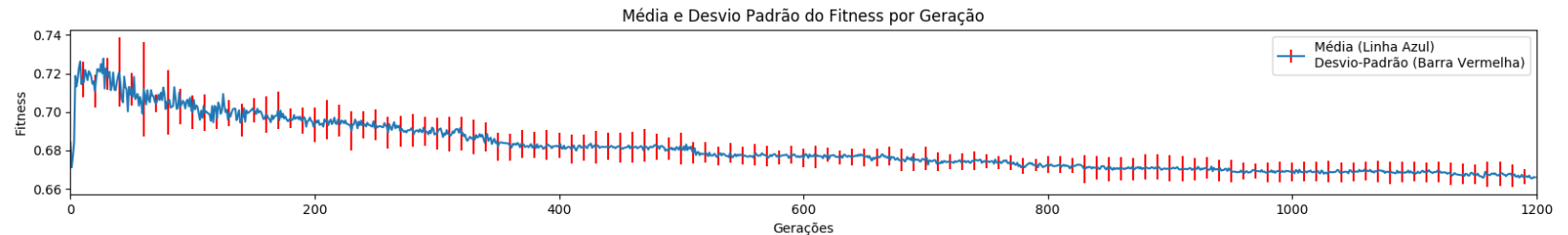
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Caso de Teste = 30.0 % de Opositores, Fitness = Grupo, Valor de C = 10, Bônus = 0.0 %

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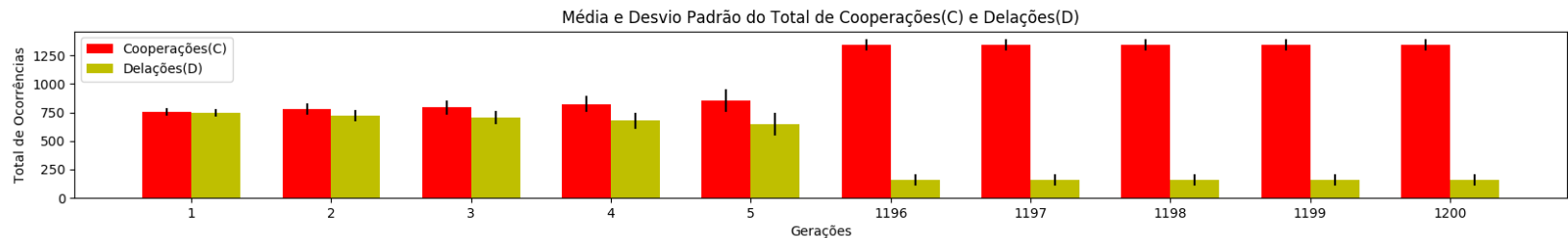
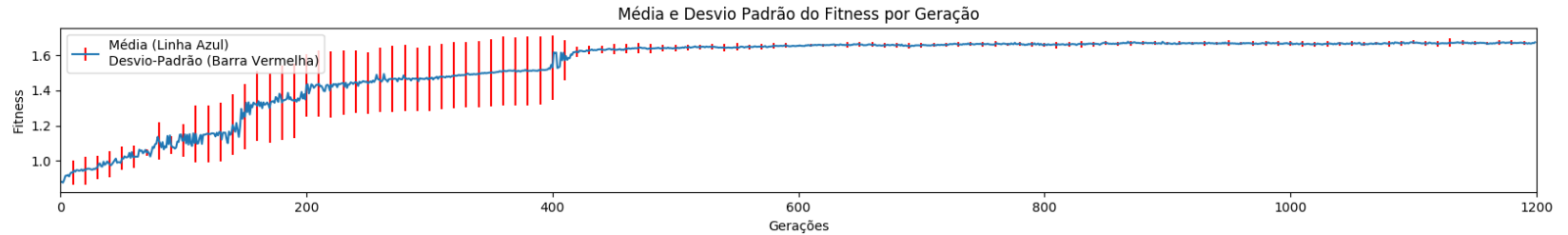
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Caso de Teste = 30.0 % de Opositores, Fitness = Individual, Valor de C = 10, Bônus = 20.0 %

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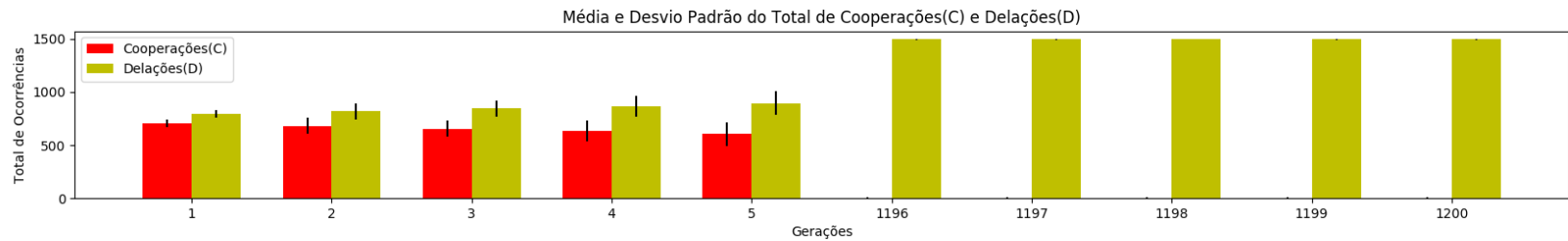
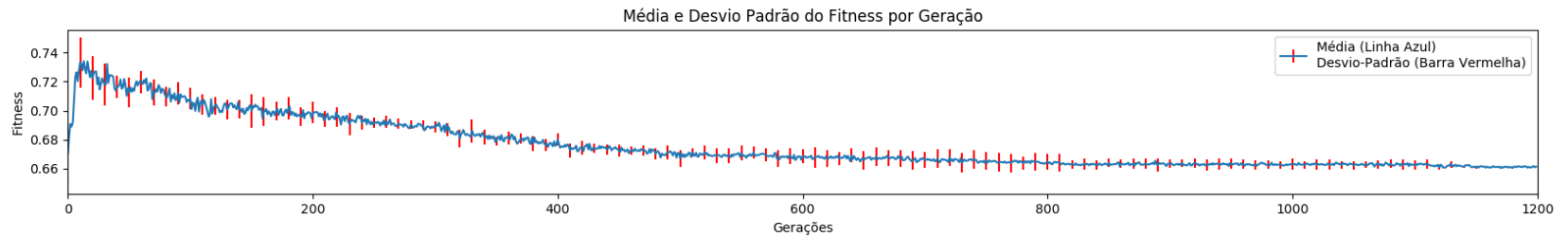
Caso de Teste = 30.0 % de Opositores, Fitness = Grupo, Valor de C = 10, Bônus = 20.0 %



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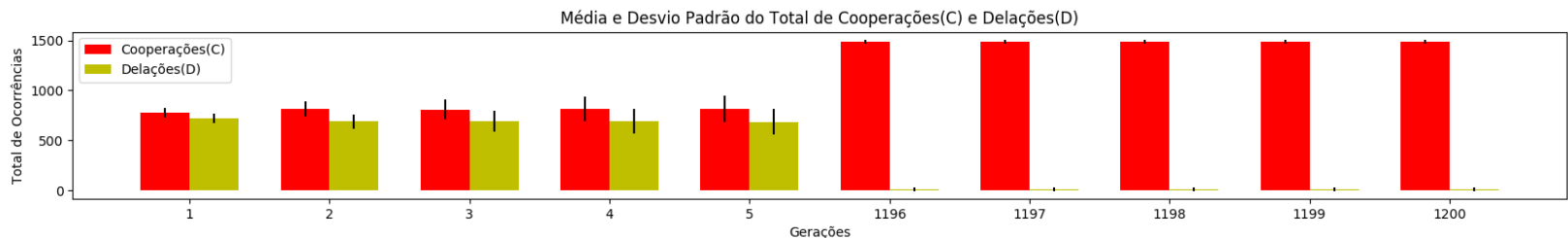
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Caso de Teste = 30.0 % de Opositores, Fitness = Individual, Valor de C = 20, Bônus = 20.0 %



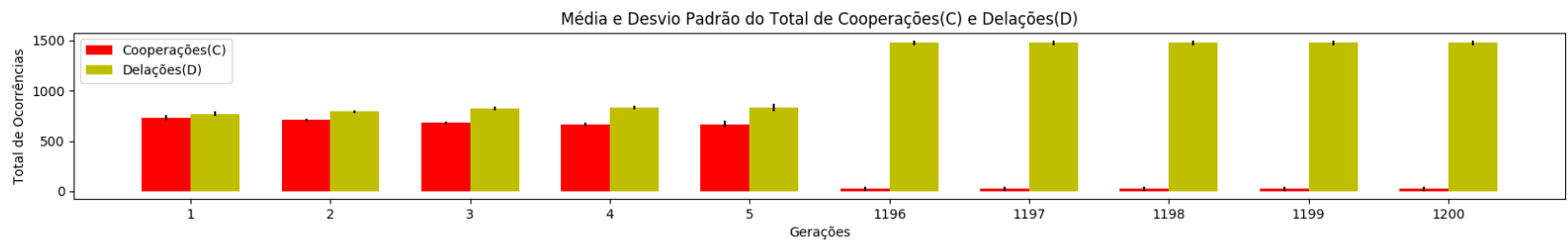
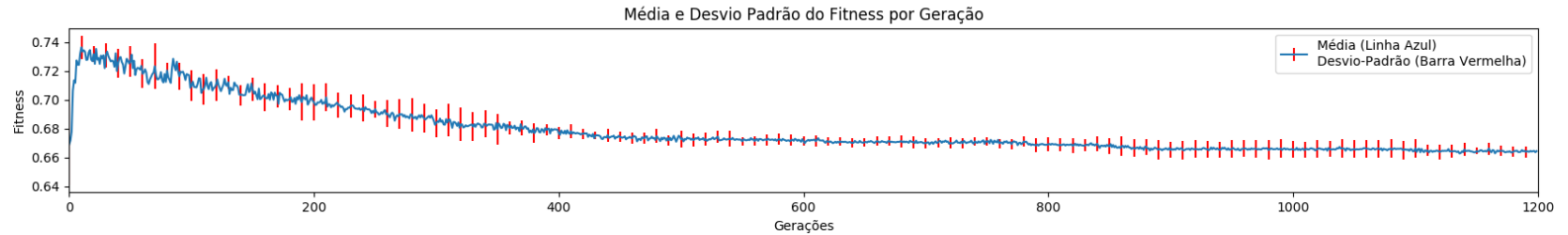
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1	D,D
2	D,D
3	D,D
4	D,D
5	D,D

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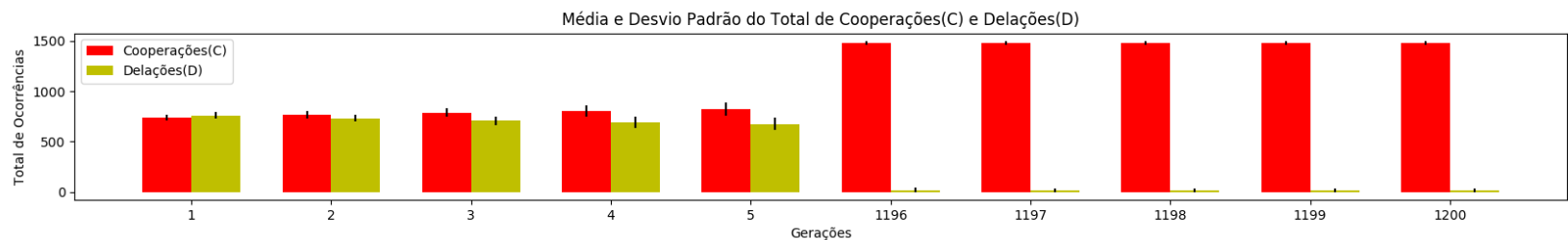
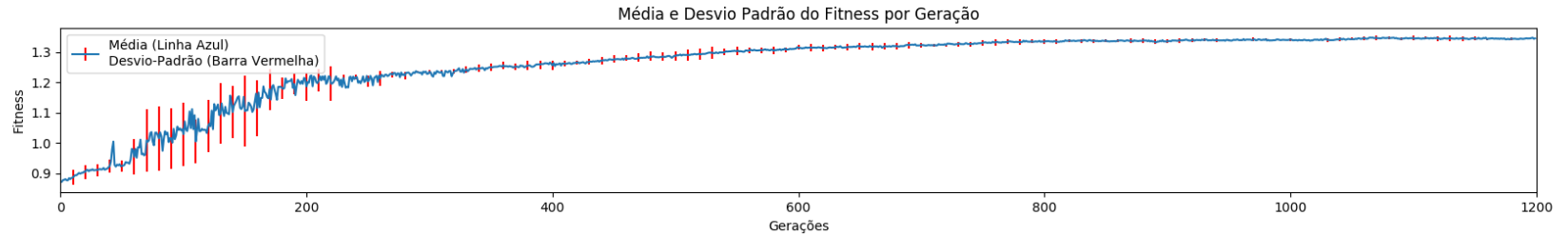
Caso de Teste = 30.0 % de Opositores, Fitness = Individual, Valor de C = 20, Bônus = 40.0 %



	Melhor Indivíduo
1	D,D
2	D,D
3	D,D,D,D,D,D,D,C,D,D,D,D,D,D,D,D,D,D,D,D,D,D
4	D,D
5	D,C,D

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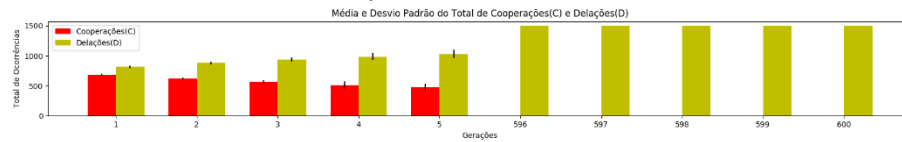
Caso de Teste = 30.0 % de Opositores, Fitness = Grupo, Valor de C = 20, Bônus = 40.0 %



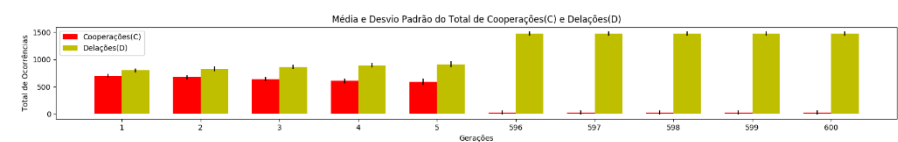
	Melhor Indivíduo
1	C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,C,D,C,C
2	C,C
3	C,C
4	C,C
5	C,C

Resultados (Fitness Individual)

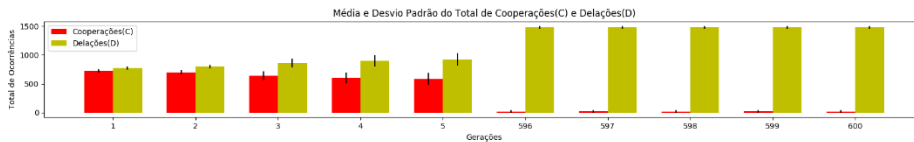
Par-a-par, C=10, Bônus = 0%



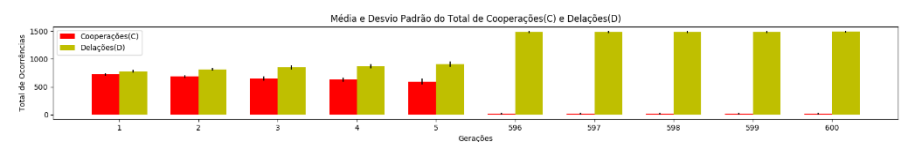
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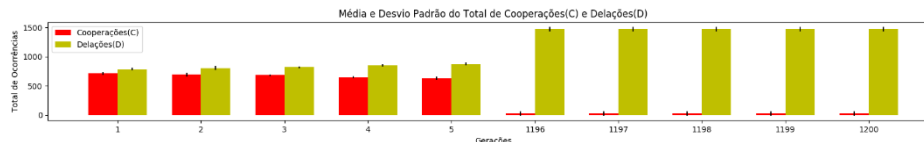
Par-a-par, C=20, Bônus = 20%



Par-a-par, C=20, Bônus = 40%



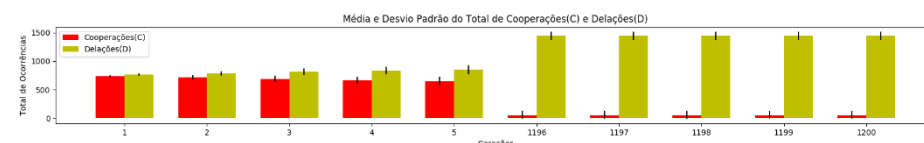
10% de Opositores, C=10, Bônus = 0%



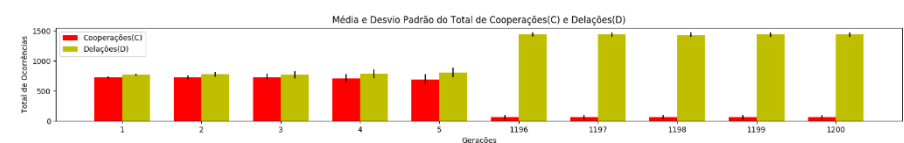
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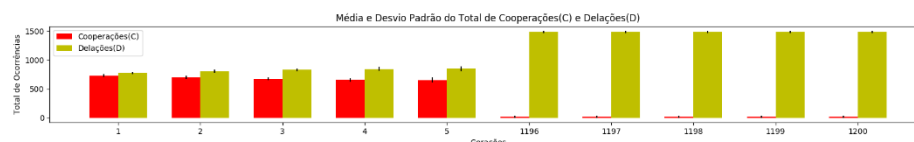
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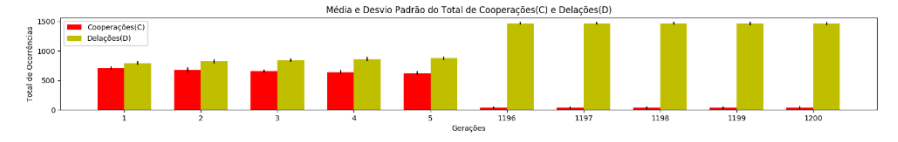
10% de Opositores, C=20, Bônus = 40%



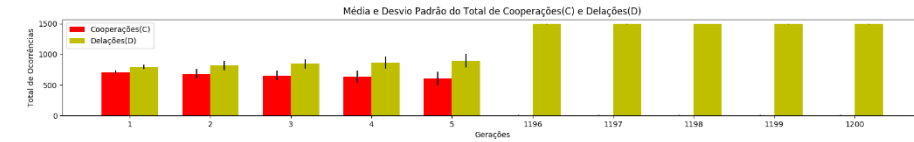
30% de Opositores, C=10, Bônus = 0%



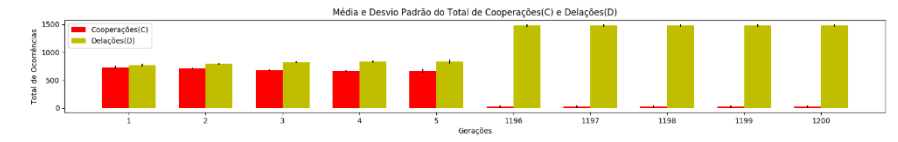
30% de Opositores, C=10, Bônus = 20%



30% de Opositores, C=20, Bônus = 20%

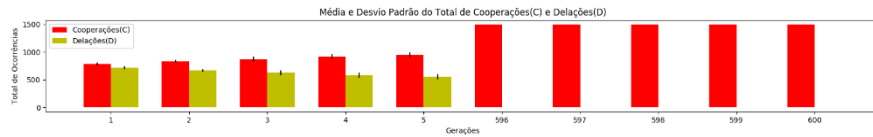


30% de Opositores, C=20, Bônus = 40%



Resultados (Fitness em Grupo)

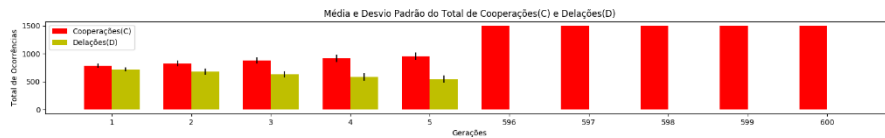
Par-a-par, C=10, Bônus = 0%



Par-a-par, C=10, Bônus = 20%



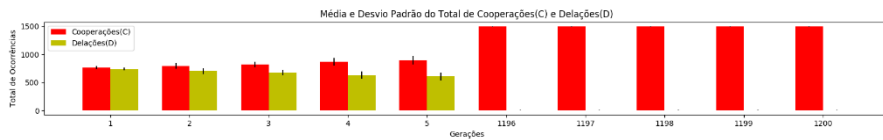
Par-a-par, C=20, Bônus = 20%



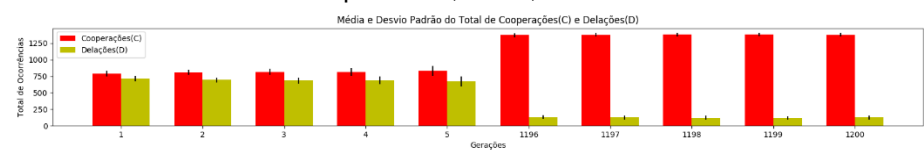
Par-a-par, C=20, Bônus = 40%



10% de Opositores, C=10, Bônus = 0%



10% de Opositores, C=10, Bônus = 20%



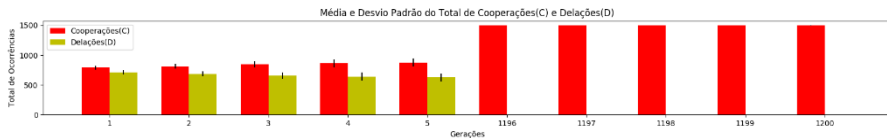
10% de Opositores, C=20, Bônus = 20%



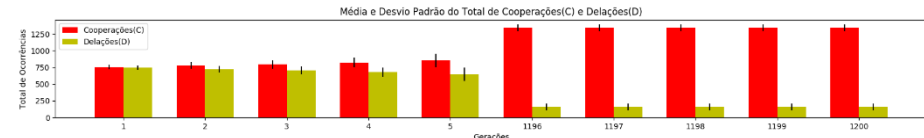
10% de Opositores, C=20, Bônus = 40%



30% de Opositores, C=10, Bônus = 0%



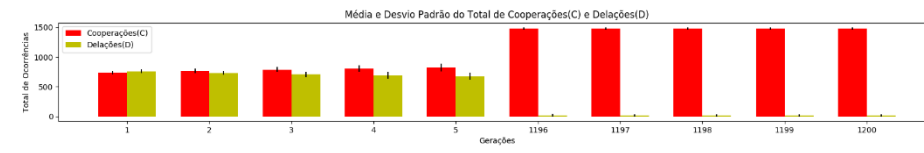
30% de Opositores, C=10, Bônus = 20%



30% de Opositores, C=20, Bônus = 20%



30% de Opositores, C=20, Bônus = 40%



Conclusão

- Qual é o impacto do tamanho de C ? A população fica mais ou menos egoísta com a variação de C ?
 - A variação do tamanho de C , quanto mais elevado, deixou a população mais egoísta.

Conclusão

- O mesmo para o valor do bônus: qual o valor do bônus para uma dada cadeia para que a população se torne menos egoísta?
 - Valores de bônus mais elevados tendem a tornar uma população menos egoísta em uma dada cadeia, como por exemplo, em aumentar o bônus de 10% para 20% com $C = 10$, surgem mais cooperações.

Conclusão

- Qual é a diferença de comportamento para Fitness Individual e o Fitness em Grupo?
 - Para o *Fitness* Individual, os indivíduos tendem a delatar, e para o *Fitness* em Grupo, os indivíduos tendem a cooperar.

Conclusão

- Quanto mais indivíduos são usados para comparação qual é o comportamento?
 - Quanto mais indivíduos são usados para comparação, mais lentamente a população convergiu, no caso, para 10% e 30% de opositores foi necessário testes com 1200 gerações para se observar a convergência.

Agradecimentos



Thank You!