

An Evolutionary Approach for Forex Trading Based on Technical Indicators

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Outline

- 1 Technical Analysis
 - Definition
 - Technical Indicators
- 2 Currency Strength Strategy
- 3 Evolutionary Approach
- 4 Results
- 5 References

Definition

- Murphy (1999) defines Technical Analysis as “the study of market action, primarily through the use of charts, for the purpose of forecasting future price trends”

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 - ▶ Volume
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- Market action information sources (Murphy, 1999):
 - ▶ Price
 - ▶ Volume
 - ▶ Open interest
- Philosophy (Murphy, 1999):
 - ▶ Market action discounts everything
 - ▶ Prices move in trends
 - ▶ History repeats itself

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Simple Moving Average – SMA

$$SMA(p, n) = \sum_{i=1}^n \frac{p_i}{n}$$

Examples of SMA¹ with 5, 30 and 80 periods:



¹<http://www.fmlabs.com/reference/default.htm?url=SMA.htm>

Relative Strength Index – RSI

$$RSI(p, n) = 100 - \frac{100}{1 - RS}$$
$$RS = \frac{AvgUp}{AvgDn}$$

Example of RSI (Wilder Jr, 1978) with 14 periods:



Stochastic Oscillator

$$\begin{aligned}\%K &= \frac{\text{close} - \text{lowest}(n_K)}{\text{highest}(n_K) - \text{lowest}(n_K)} \\ \%D &= \text{MA}(\%K, n_D)\end{aligned}$$

Example of Stochastic Oscillator (Lane and M.D., 1984) with $n_K = 14$, $n_D = 3$ periods:



Stochastic RSI

Apply Lane's Stochastic Oscillator over Wilder's Relative Strength Index



Fibonacci Retracement Lines

Fibonacci Retracement Lines are placed according to some ratios present in the Fibonacci sequence²:

$$F_{n+1} = F_n + F_{n-1}$$

$$\frac{F_n}{F_{n-1}} \approx 1.618$$

$$\frac{F_n}{F_{n+1}} \approx 0.618$$

$$\frac{F_n}{F_{n+2}} \approx 0.382$$

$$\frac{F_n}{F_{n+3}} \approx 0.236$$

²http://stockcharts.com/school/doku.php?id=chart_school:chart_analysis:fibonacci_retracemen

Fibonacci Retracement Lines

These lines are used as support and resistance levels



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 - Strength Matrixes
 - Selecting Currencies
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Currency Strength Strategy

Based on the strength of the following currencies and the 21 currency pairs resulting of their combination

Symbol	Name
AUD	Australian Dollar
CAD	Canadian Dollar
EUR	Euro
GBP	Pound Sterling
JPY	Japanese Yen
NZD	New Zealand Dollar
USD	United States Dollar

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Currency Strength – Strength Matrixes

- Matrix 1: if the current price is above $SMA(Close, n)$
 $\rightarrow m \in \{-1, 1\}$
- Matrix 2: if the current price has retracted to Fibonacci's 0.382 level (using $SMA(Close, n)$)
 $\rightarrow m \in \{-1, 0, 1\}$
- Matrix 3: $M1 + M2 \rightarrow m \in [-2, 2] \cap \mathbb{Z}$
- Vector 4: sum of columns for each line $\rightarrow v \in [-12, 12] \cap \mathbb{Z}$

$$v[i] = \sum_{j=1}^7 x_{ij}, i = 1, 2, \dots, 7$$

- Matrix 4: strength difference between currencies
 $\rightarrow m \in [-24, 24] \cap \mathbb{Z}$

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Currency Strength – Selecting Currencies

Loop in time, taking risk per order and maximum risk into account.

- Choose, based on $M4$, the group of pairs with the higher strength difference (≥ 6)
- Do not choose pairs which currencies have absolute strength (vector 4) below 4
- Some definitions
 - ▶ Stop loss is placed 15 pips below the last bottom
 - ▶ Take profit is placed $3 * (current - SL)$ pips above current price (TP:SL = 3:1)
 - ▶ Stochastic RSI:
 $stoch(RSI(n = 14), fastK = 5, fastD = 5, slowD = 3)$, using $fastD (\%D)$

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Estratégia de Julho – Order Management

- Order is open following the strength given by Matrix 4. BUY order example:
 - ▶ Current price is above $SMA(High, n)$ by at least 5 pips
 - ▶ Stochastic RSI is below 20% or 70% but falling
 - ▶ Pair strength given by $M3$ is 2 (max)
 - ▶ Last bottom must be below current price
 - ▶ When the candle opens below last top price the SL is updated to 15 pips below the last bottom
- Lot size is calculated based on risk per order

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 - Genetic Algorithms
 - Chromosome structure
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Genetic Algorithms

- Developed by Holland (1975), Genetic Algorithms are probabilistic search methods inspired by natural selection and genetics (Cunha et al., 2012).
- Reproduction, competition, mutation and selection

Algorithm 1 Genetic Algorithm Structure (Cunha et al., 2012)

```
1:  $t \leftarrow 0$ 
2: Generate initial population  $P(t)$ 
3: Evaluate individuals from  $P(t)$ 
4: while Stopping criteria is not reached do
5:   Select parents  $P'(t)$  from  $P(t)$ 
6:   Apply genetic operators to  $P'(t)$  to obtain new population  $P(t+1)$ 
7:   Evaluate  $P(t+1)$ 
8:    $t \leftarrow t+1$ 
9: Retrieve optimization final result
```

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Cromosome structure

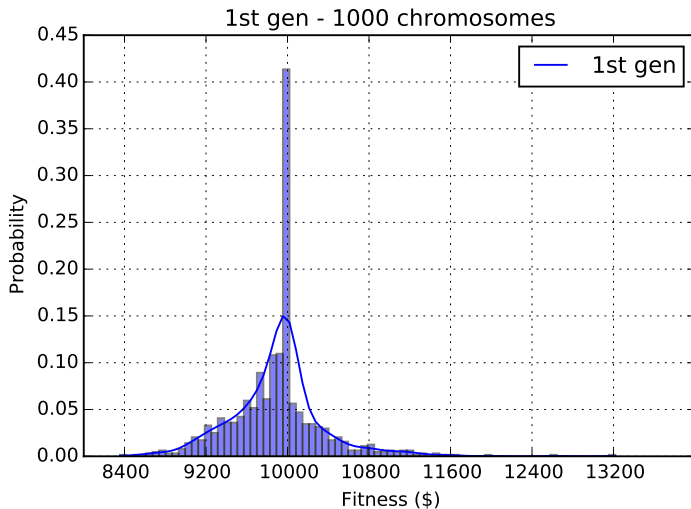
Vector with 240 integer values

- Risk per order and total risk (2)
- Update SL – pips until SL (21)
- Pair selection – SMA periods (21)
- Pair selection – Minimum pair strength difference given by M4 (21)
- Pair selection – Minimum currency strength given by V4 (7)
- Fibonacci – SMA periods (21)
- Pair selection – Minimum distance from SMA (21)
- Stochastic RSI – RSI periods (21)
- Stochastic RSI – Stochastic periods %K, %D and slowD (3*21)
- Order Management – Distance from last bottom to place Stop Loss (21)
- Order Management – Ratio TP:SL (21)

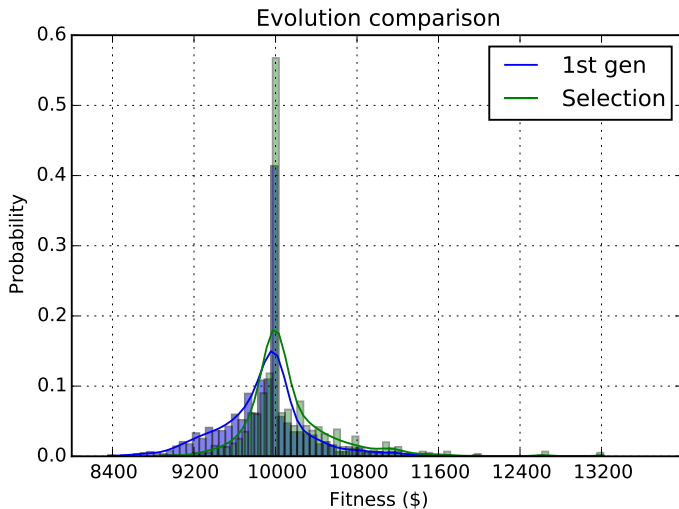
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 - 1000 chromosomes
 - 100 chromosomes
 - 100 chromosomes with seed
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Results – First generation 1000 chromosomes



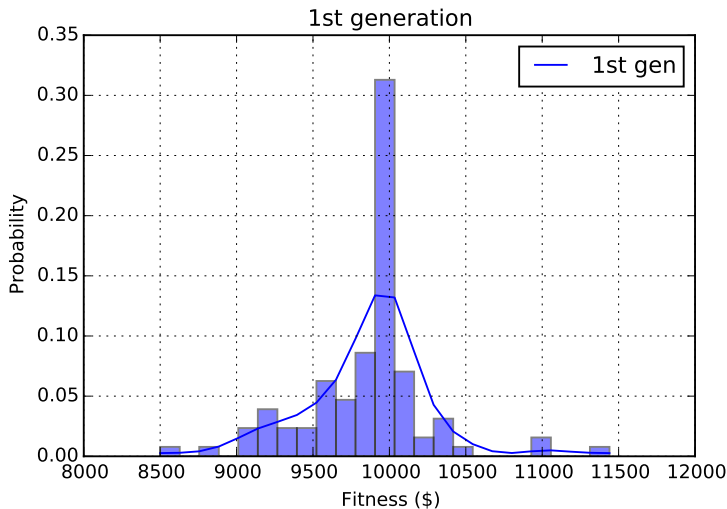
Results – Selection



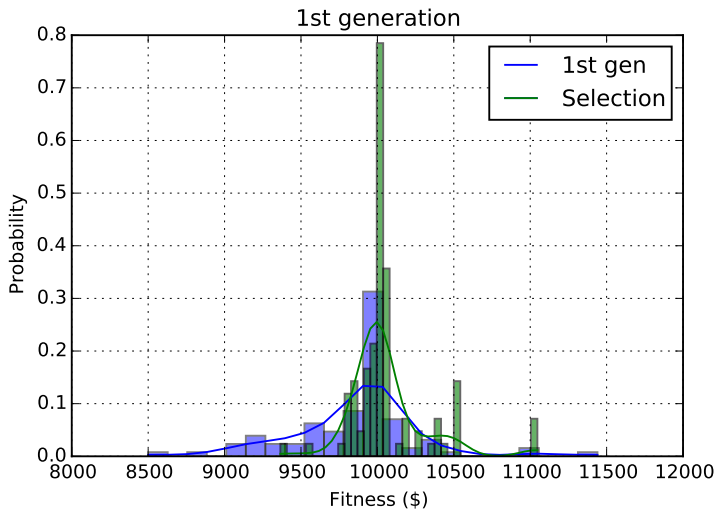
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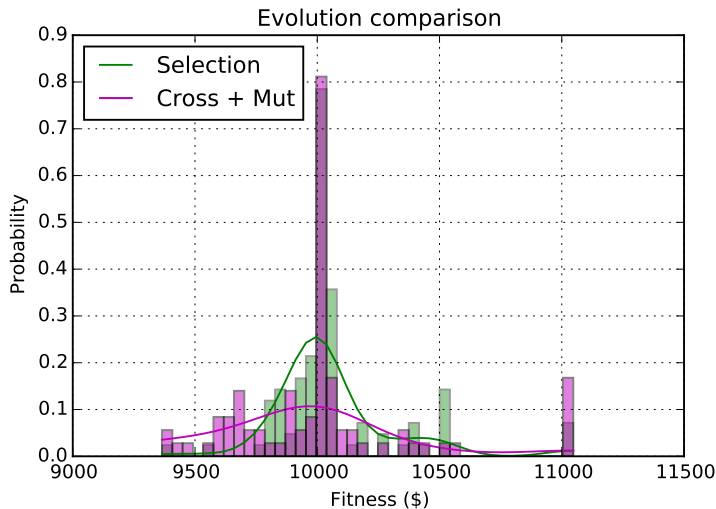
Results – First generation 100 chromosomes



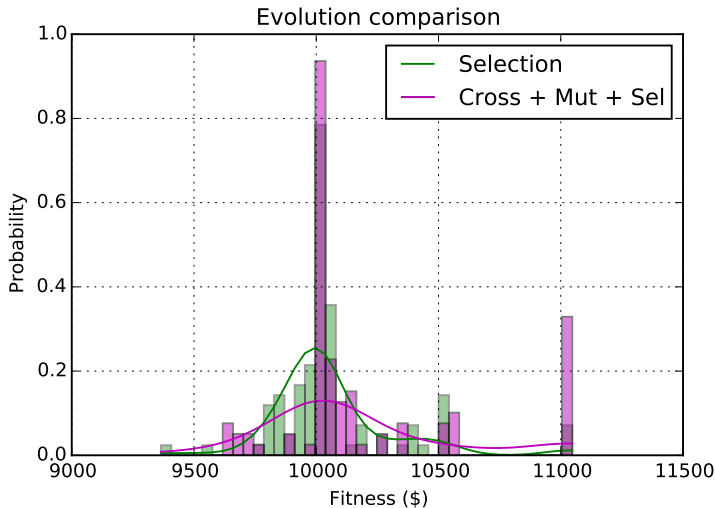
Results – Selection



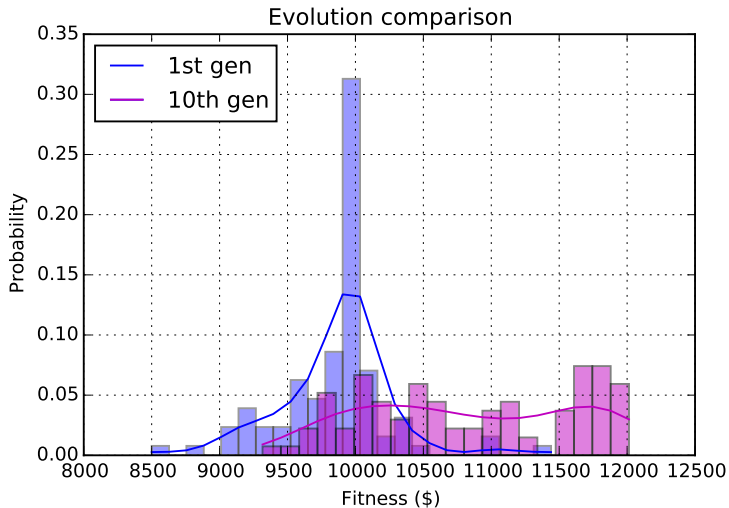
Results – Selection, crossover and mutation



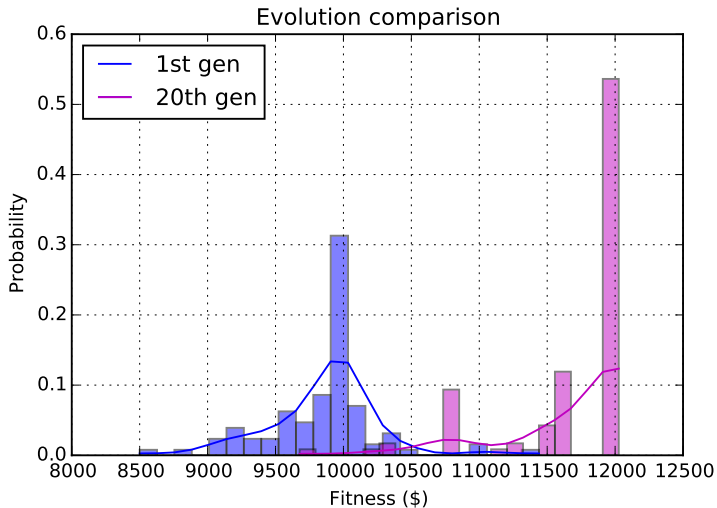
Results – Crossover, mutation and selection



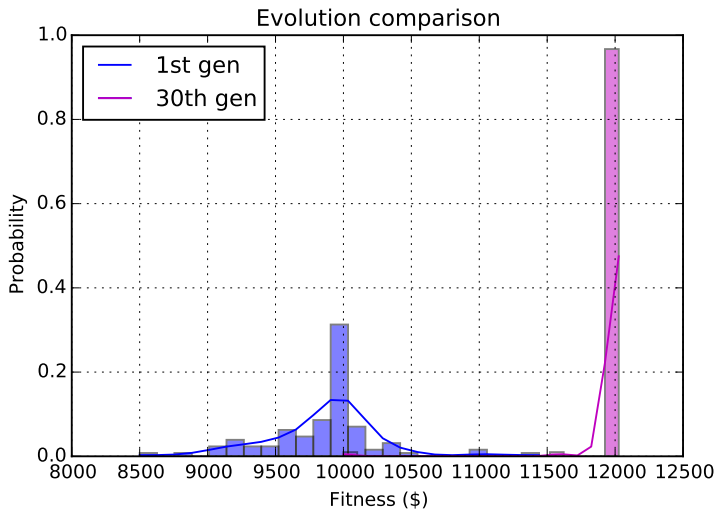
Results – 10th generation



Results – 20th generation



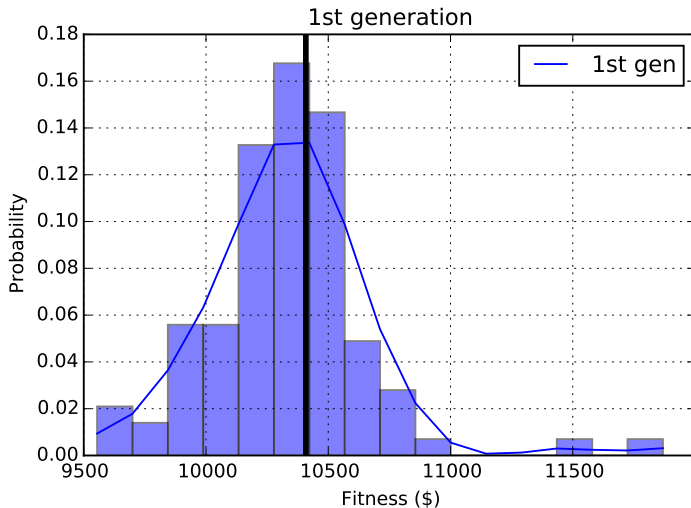
Results – 30th generation



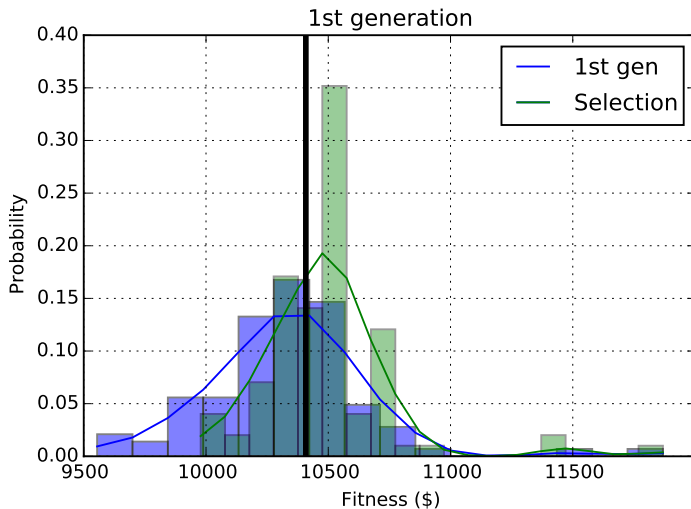
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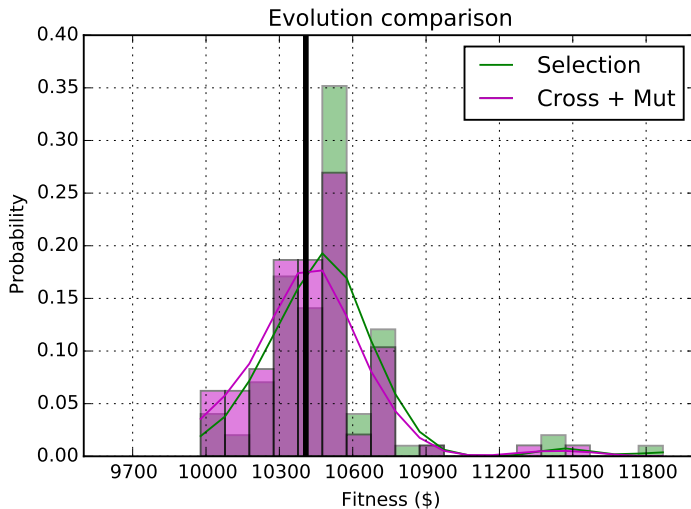
Results – First generation 100 chromosomes around seed



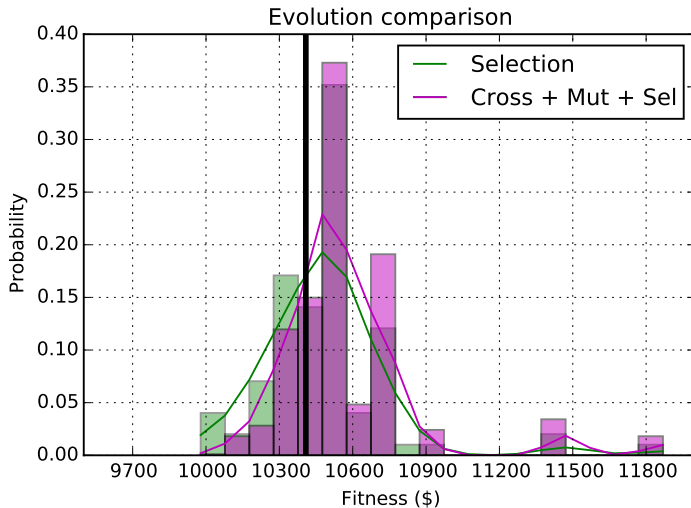
Results – Selection



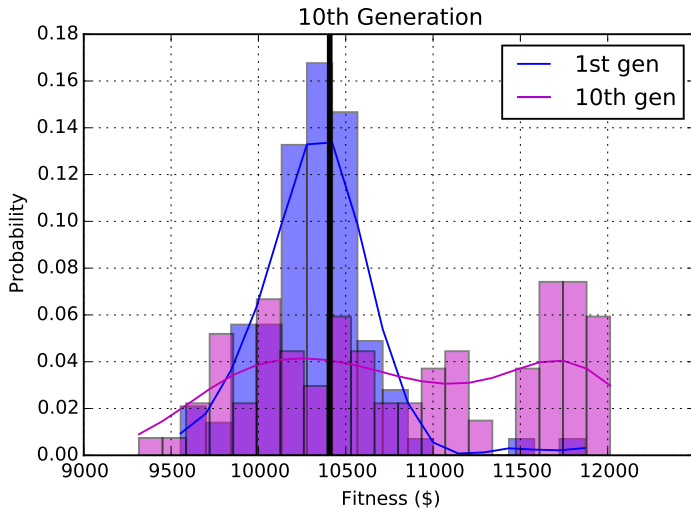
Results – Selection, crossover and mutation



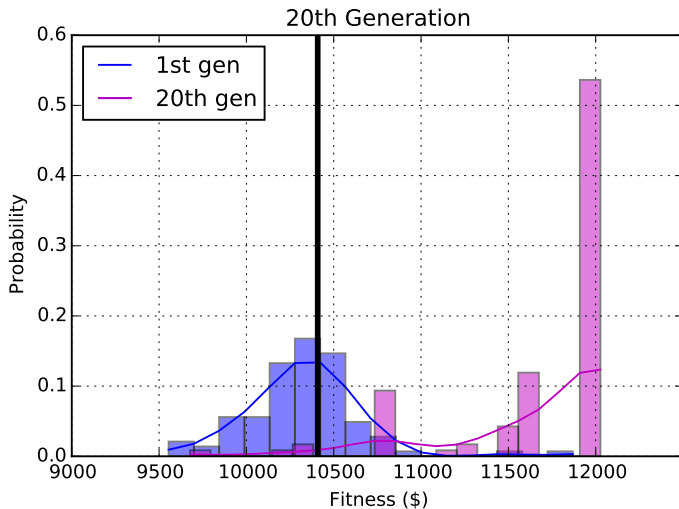
Results – Crossover, mutation and selection



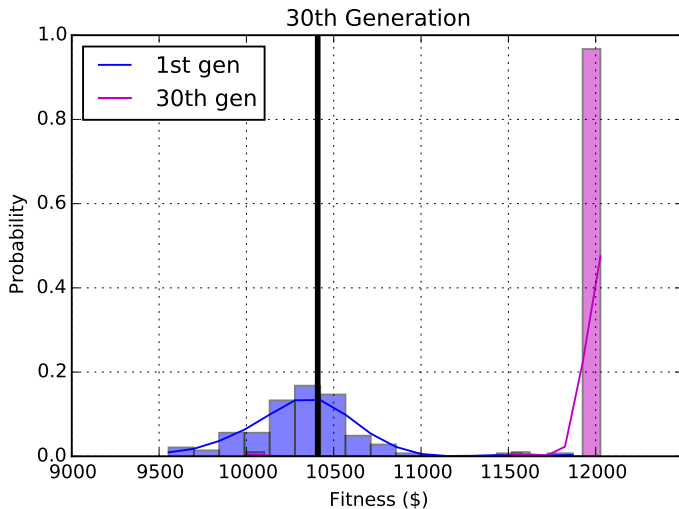
Results – 10th generation



Results – 20th generation



Results – 30th generation



References I

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