ECE 449 In-class exercise #18 - Genetic algorithms **Fall 2019**

Problem: Find value of x that maximizes function $f(x) = x^2$ for integer values of $0 \leq x \leq 255$. Concentrate only on representation, initialization, and selection

1. **Representation** – numbers up to 255 can be represented by 8 bits ($2^8 = 256$) – use 8-bit binary code

2. **Initialization** – randomly generate e.g. 5 elements/individuals of the population

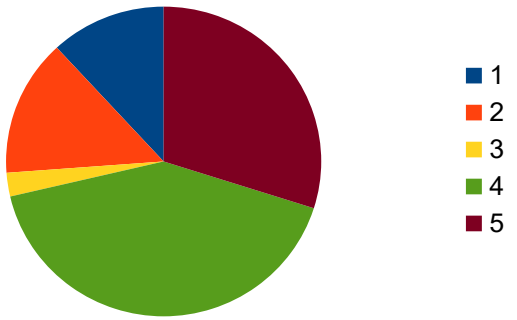
#	Code
1	01011100
2	01100101
3	00101010
4	10101100
5	10010010

3. **Selection**

a) fitness proportional: evaluate fitness of each individual, and assign it a probability of selection proportional to its relative fitness within the population

#	Code	x	Fitness	Percentage	Probability	Cumulative
1	01011100	92	8464	11.87%	0.12	0.12
2	01100101	101	10201	14.30%	0.14	0.26
3	00101010	42	1764	2.47%	0.02	0.29
4	10101100	172	29584	41.48%	0.41	0.70
5	10010010	146	21316	29.88%	0.30	1.00
			∑=71329	100.00%	1.00	

This corresponds to selection using a biased roulette wheel – each sector has area corresponding to the relative (percentage) fitness of the individual:



Individuals are then selected by generating a random number, and selecting an individual based on the interval (roulette sector) the number falls in.

b) rank: assign rank to each individual based on its fitness, and then distribute the probability of individual selection based on the ranks (not fitness)

#	Code	x	Fitness	Rank	Percentage	Probability	Cumulative
1	**01011100**	92	8464	2	13.33%	0.13	0.13
2	**01100101**	101	10201	3	20.0%	0.20	0.33
3	**00101010**	42	1764	1	6.67%	0.07	0.40
4	**10101100**	172	29584	5	33.33%	0.33	0.73
5	**10010010**	146	21316	4	26.67%	0.27	1.00
			∑=71329	∑=15	100.00%	1.00	

This corresponds to selection using a biased roulette wheel – each sector has area corresponding to the relative (inverse) rank of the individual: