Assignment 15 Other selection mechanisms

For a **maximization problem** we have the following population of an evolutionary algorithm, which consists of 10 individuals (A to J):

Indiv.	Fitness	Indiv.	Fitness
A	5	F	4
B	13	G	8
C	3	H	20
D	2	I	1
E	4	J	3

Please answer the following questions:

- Explain the Universal Stochastic Sampling method and which advantage does it have with respect to Roulette Wheel selection.

Stochastic Universal Sampling (SUS):

- In this technique, one random variable, *v* (rotation of the wheel) is chosen for the whole selection process. $v \in [0, \sum \frac{f_i}{n}]$
- Since *n* different solutions have to be chosen, the first solution is chosen according to the location of the random number on the periphery of the wheel.
- Pointers are placed at identical distances along the periphery of the roulette wheel.
- Other individual solutions are selected sequentially using,

$$v + k \sum \frac{f_i}{n} \, , k = 0, 1, \ldots, n-1$$

- Each individual is selected at least $\lfloor np_i \rfloor$ times and at most $\lceil np_i \rceil$ times.

Advantage:
In the traditional RWS method, it is possible that the worst individual is selected *n* times leading to **high genetic drift**. To overcome this the SUS method has *n* markers corresponding to the number of solutions.

- We want to select 7 individuals from this population using Stochastic Universal Sampling with the given order of the individuals (A-J). The initial random number that is needed for this approach is chosen as $v = 3.0$. Which 7 individuals are selected?

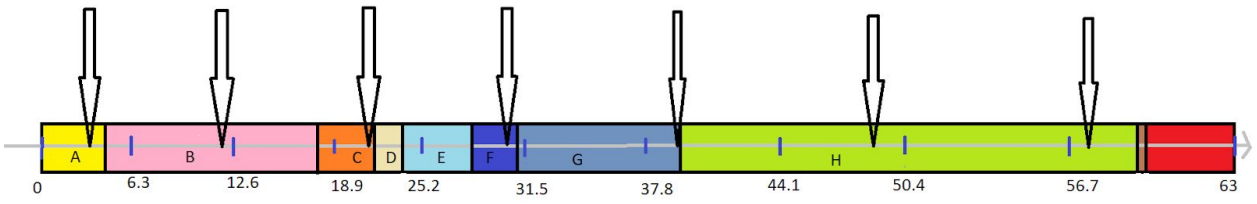
Individual	Fitness, f_i	p_i
A	5	0.07
B	13	0.20
C	3	0.04
D	2	0.03
E	4	0.06
F	4	0.06
G	8	0.12
H	20	0.31
I	1	0.01
J	3	0.04
	$\sum = 63$	

$\sum \mathbf{f}_i/n = 9$, v = 3, n=7

Sample on 3 + k * 9, for k = 0...6

Working

k	**Sample on**
0	3 + *0* * 9 = 3
1	3 + *1* * 9 = 12
2	3 + *2* * 9 = 21
3	3 + *3* * 9 = 30
4	3 + *4* * 9 = 39
5	3 + *5* * 9 = 48
6	3 + *6* * 9 = 57



- If the individuals in the first column (A-E) are the parents, and the individuals in the second column (F-J) are the offspring, what solutions will be selected for the next generation with (μ, λ)-selection? Which ones will be selected with $(\mu + \lambda)$-selection?

If we compute the average of the parent population we obtain $f_{avg}^{parent} = 5.4$ and for $f_{avg}^{offspring} = 7.2$

For **(μ,λ)** selection we check for $f_{avg}^{parent} > 5.4$ in the child pool and we retain solutions **G(8)** and **H(20).**
For **(μ+λ)** selection we check for $f_{avg}^{parent} > 5.4$ in the parent pool and we retain solution **B(13)** and from child pool $f_{avg}^{offspring} > 7.2$ and we select solutions **G(8)** and **H(20).**