MB University of M'sila
Faculty of MI
Department of Computer Science
Master 2 IDO

Optimization Methods
Normal session exam January 2025
Duration : 1 hour 30 minutes

Exercise 1 (Course questions / 04 points)

1) **Crossover** 0.5
2) **Scoot recruitment** 0.5
3) **Because a solution is a tree** 0.5
4) **Move probability** 0.5
5) **ACO is constructive** 0.5
6) **"a dominates b" =** $\forall i \in [1,k] : f_i(a) \leq f_i(b)$ *and* $\exists\, i \in [1,k] : f_i(a) < f_i(b)$ **;** 0.5
   "Efficient solution" = a solution that is not dominated; 0.5
   "Pareto front" = set of all efficient solutions. 0.5

Exercise 2 (09 points)

1) **There is (n-1)!/2 = 3 tours = ABCD ; ABDC ; ACBD. (□ , ⧖ , ⋈)** 2
2) **P(C,A) =** $\frac{\tau_{CA}^{\alpha}\eta_{CA}^{\beta}}{\tau_{CA}^{\alpha}\eta_{CA}^{\beta}+\tau_{CB}^{\alpha}\eta_{CB}^{\beta}+\tau_{CD}^{\alpha}\eta_{CD}^{\beta}} = \frac{\frac{1}{5}}{\frac{1}{5}+\frac{1}{2}+\frac{1}{3}} = \frac{6}{31}$ **;** $\mathbf{P(C,B)} = \frac{\frac{1}{2}}{\frac{1}{5}+\frac{1}{2}+\frac{1}{3}} = \frac{15}{31}$ **;** $\mathbf{P(C,D)} = \frac{\frac{1}{3}}{\frac{1}{5}+\frac{1}{2}+\frac{1}{3}} = \frac{10}{31}$ 1.5
3) **P(A,B) =** $\frac{\tau_{AB}^{\alpha}\eta_{AB}^{\beta}}{\tau_{AB}^{\alpha}\eta_{AB}^{\beta}+\tau_{AD}^{\alpha}\eta_{AD}^{\beta}} = \frac{\frac{1}{3}}{\frac{1}{3}+\frac{1}{2}} = \frac{2}{5}$ **; P(A,D) = 1-** $\frac{2}{5} = \frac{3}{5}$ 1
4) **P(D,B) =** *1.* 0.5
5) **We notice that CADB = ACBD, therefore, 2 ants built the same tour ABCD (10), and the 2 others built the same tour ACBD (13). Length(ABCD) = 10 ; Length(ACBD) = 13 ;** 1

$$\tau_{AB} = (1-\rho).\tau_0 + \frac{2.Q}{\text{Length(ABCD)}} = 2.20$$

$$\tau_{AC} = (1-\rho).\tau_0 + \frac{2.Q}{\text{Length(ACBD)}} = 1.73$$

$$\tau_{AD} = (1-\rho).\tau_0 + \frac{2.Q}{\text{Length(ABCD)}} + \frac{2.Q}{\text{Length(ACBD)}} = 3.73$$

$$\tau_{BC} = (1-\rho).\tau_0 + \frac{2.Q}{\text{Length(ABCD)}} + \frac{2.Q}{\text{Length(ACBD)}} = 3.73$$

$$\tau_{BD} = (1-\rho).\tau_0 + \frac{2.Q}{\text{Length(ACBD)}} = 1.73$$

$$\tau_{CD} = (1-\rho).\tau_0 + \frac{2.Q}{\text{Length(ABCD)}} = 2.20$$ 3

Exercise 3 (07 points)

1)
```
Void initialization (){
For(i=0 ; i<m ; i++)
      For(j=0 ; j<n ; j++)
            Pop[i][j]=int(rand()*2);
            Velocity[i][j]
      For(j=0 ; j< int(rand()*n) ; j++)
            Velocity[i][j]= int(rand()*n)
```
.... 1

2) $x \oplus v = 100111$ 0.5

```
Int[] ADD (int[] x , int[] v){
r=x;
For(i=0 ; i<len(v) ; i++)
      r[i]=1-r[i];
Return r;
```
.... 1

3) $x_1 \ominus x_2 = \{1,5,6\}$ 0.5

```
Int[] SUB(int[] x1 , int[] x2){
k=0;
For(i=0 ; i<n ; i++)
      If (x1[i] != x2[i] )
                { v[k]=I ; k++;}
Return v;
```

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4) $v_1 \boxplus v_2 = \{1, 2, 4, 5\}$ ……………………………………………………………………………………0.5

```
Int[] SUM (int[] v1 , int[] v2){
k=0;
For(i=0 ; i<len(v1) ; i++)
       { v[k]= v1[i] ; k++;}
For(i=0 ; i<len(v2) ; i++) {
        Found = 0 ;
        For(j=0 ; j<len(v1) ; j++)
             If (v2[i] == v1[j])
                   {Found = 1 ; break;}
        If (!found)
            { v[k]= v2[i] ; k++;}}
Return v;
```

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5) $a \otimes v = \{1, 4\}$. ……………………………………………………………………………………0.5

```
Int[] PROD (float a , int[] v){
k=0;
For(i=0 ; i<max(int(a+1),len(v)) ; i++)
       { r[k]= v[i] ; k++;}
Return r;
```

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