

Define fitness function Fitness(X)

Begin (1)

```
/* Step 1 - Initialisation();*/
```

```
t = 0 ;
```

```
Initialise solutions: locations  $X(0) = \{x_1, x_2, \dots, x_i, x_n\}$ ;
```

```
velocities  $V(0) = \{v_1, v_2, \dots, v_i, v_n\}$ ;
```

```
Initialise parameters: pulse frequency  $f_i$ 
```

```
pulse rate  $r_i$ 
```

```
loudness  $A_i$ 
```

```
While ( Not termination-condition) do
```

Begin (2)

```
{ t = t + 1;
```

```
/* Step 2 - Global Updating();*/
```

```
/* Step 2.1 - Movement of virtual bat generation;*/
```

```
adjusting frequency  $f_i$ ,
```

```
updating velocities  $v_i$ ;
```

```
updating locations  $x_i$  as  $x_s$ ;
```

```
/* Step 2.2 - check pulse rate  $r_i$  ;*/
```

```
if (RAND >  $r_i$ )
```

```
(1) select a solution among  $x_s$  randomly
```

```
(2) generate a global solution  $x_{global}$  within  $x_s$ 
```

```
end if
```

```
/* Step 2.3 - generate flying solution ;*/
```

```
generate a new solution  $x_{global}$  by flying randomly;
```

```
/* Step 3 - Local Updating();*/
```

```
if ( RAND <  $A_i$  && Fitness( $x_i$ ) < Fitness( $x_{global}$ ) )
```

```
(1) accept the new solutions  $x_s$ 
```

```
(2) update  $r_i$  and  $A_i$  - increase  $r_i$  and reduce  $A_i$ 
```

```
(3) find the local best  $x_{local}$ 
```

```
end if
```

```
/* Step 4 - Generate final output: global result + local result */
```

```
if ( Fitness( $x_{global}$ ) < Fitness( $x_{local}$ ) )
```

```
 $x_i$  =  $x_{local}$  ;
```

```
else
```

```
 $x_i$  =  $x_{global}$ ;
```

```
end if
```

End (2)

```
End While
```

End (1)