b. Developing PSO code

```
hold off; clear; close all; clc;
```

Define the eggholder function

```
fun = @(x)(-(x(2)+47)*sin(sqrt(abs((x(1)/2) + (x(2) + 47)))) + ...
    - x(1)*sin(sqrt(abs(x(1) - (x(2) +47)))))
```

```
fun = function_handle with value:
    @(x)(-(x(2)+47)*sin(sqrt(abs((x(1)/2)+(x(2)+47))))+-x(1)*sin(sqrt(abs(x(1)-(x(2)+47)))))
```

```
% True value of global optimum (check function works) and for comparison
% later
true = fun([512, 404.2319]);
```

Run `x = particleswarm(fun,nvars)` where nvars is the number of dimensions.

```
nvars = 2;
```

The bounds are the search domain as given in the wikipedia page

```
lb = [-512,-512];
ub = [512,512];
```

The options as with all optimisation can be defined. The swarm size is simply the number of particles, and the number of iterations that are carried out is MaxIterations, after attempting with default parameters, I set the options to those shown below as it provided a correct solution quickly.

Generally a greater number of iterations and a greater swarm size will result in better results at the cost of computational price.

```
options = optimoptions('particleswarm','SwarmSize',200,MaxIterations=20);

[x, fval] = particleswarm(fun,nvars,lb,ub,options)
```

```
Optimization ended: number of iterations exceeded OPTIONS.MaxIterations.
x = 1×2
  512.0000  404.1914
fval = -959.6388
```

```
error = true - fval
```

```
error = -0.0019
```

Test for many attempts

```
hold on
for repeat = 1:20
    fvals = [];
    for i = 1: 20
        options = optimoptions('particleswarm','SwarmSize',200,MaxIterations=i);
        [x, fval] = particleswarm(fun,nvars,lb,ub,options);
        fvals(i) = true - fval;
    end
    plot(1:i,fvals,'k-',LineWidth=0.1);
    plot(1:i,fvals,'k*',LineWidth=1);
    ylabel('error');
    xlabel('number of iterations');
end
```

```
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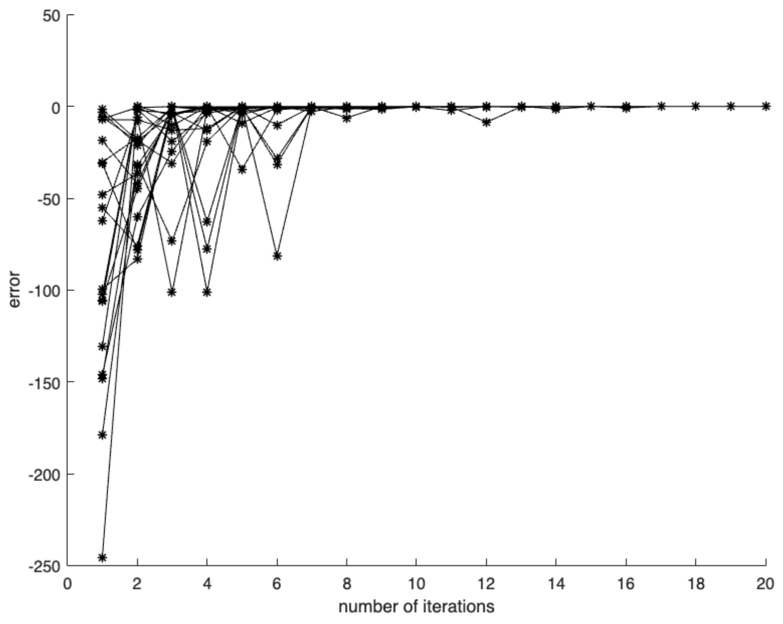

After plotting the optimisation for 20 goes at the same problem you can see the stochastic property of the algorithm and also that is it is not always guaranteed to converge in the set time steps. A better measure of convergence would be the change on previous fval estimates which would stop the algorithm from diverging after attaining a zero error.