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MF850: Advanced Computational Methods

Problem Set 2

Problem 2.1

(a) Here's the brief view of the result vectors (Using N=1000):

```
julia> V
1001-element Vector{Float64}:
  0.0
 -0.001690831717654989
 -0.003379972603271113
 -0.005067424342396961
 -0.006753188621375364
  ⋮
 -0.9989208577716838
 -0.9992819291364625
 -0.9996416434258759
 -1.0
```

(b) According to the definition:

$$q \approx \frac{\log \left| \frac{x_{n+1}-x_n}{x_n-x_{n-1}} \right|}{\log \left| \frac{x_n-x_{n-1}}{x_{n-1}-x_{n-2}} \right|}$$

The order of the convergence should be about 0.7, which is close to 1. It's a linear convergence, to be specific, a sublinear convergence.

(c) Here's the plot of the error, using N=1000.
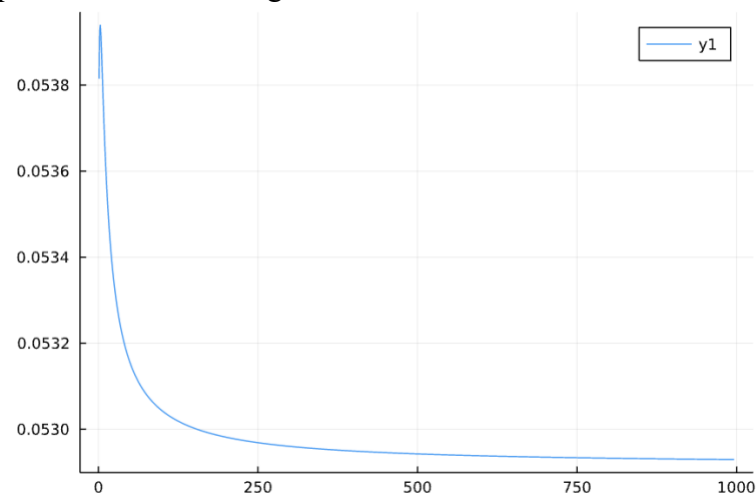
From the plot we can see the error is sublinear, we can say it's a (sub)linear convergence.

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(d) With Robin boundary condition, I got the result shown below:

```
julia> v
1001-element Vector{Float64}:
 -5.522954140218801
 -5.516434449187241
 -5.509921277845678
 -5.503414619671414
 -5.496914468146373
  ⋮
 -1.3393989576838559
 -1.336731982339805
 -1.3340666779670847
 -1.3314030408977413
```

It's close to the analytical solution as well.

Problem 2.2

The surface plot is shown below:
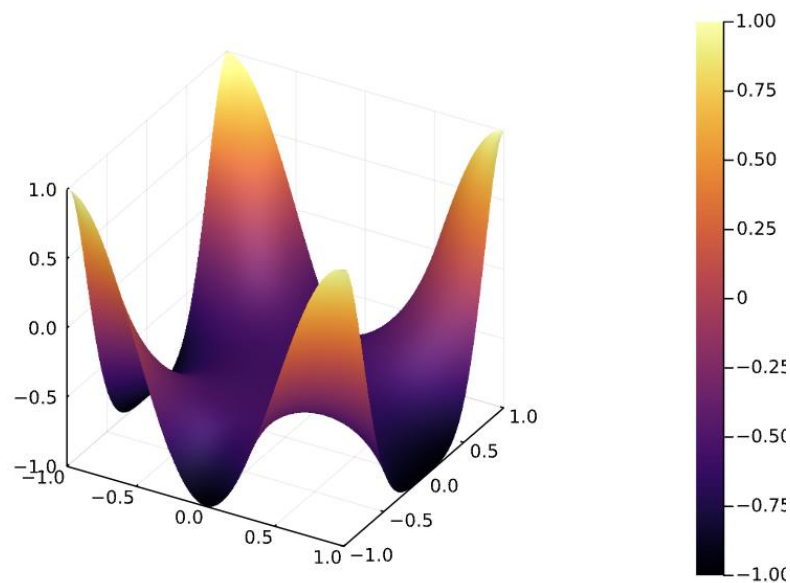
From the solution, v(-0.5,0) is about -0.62