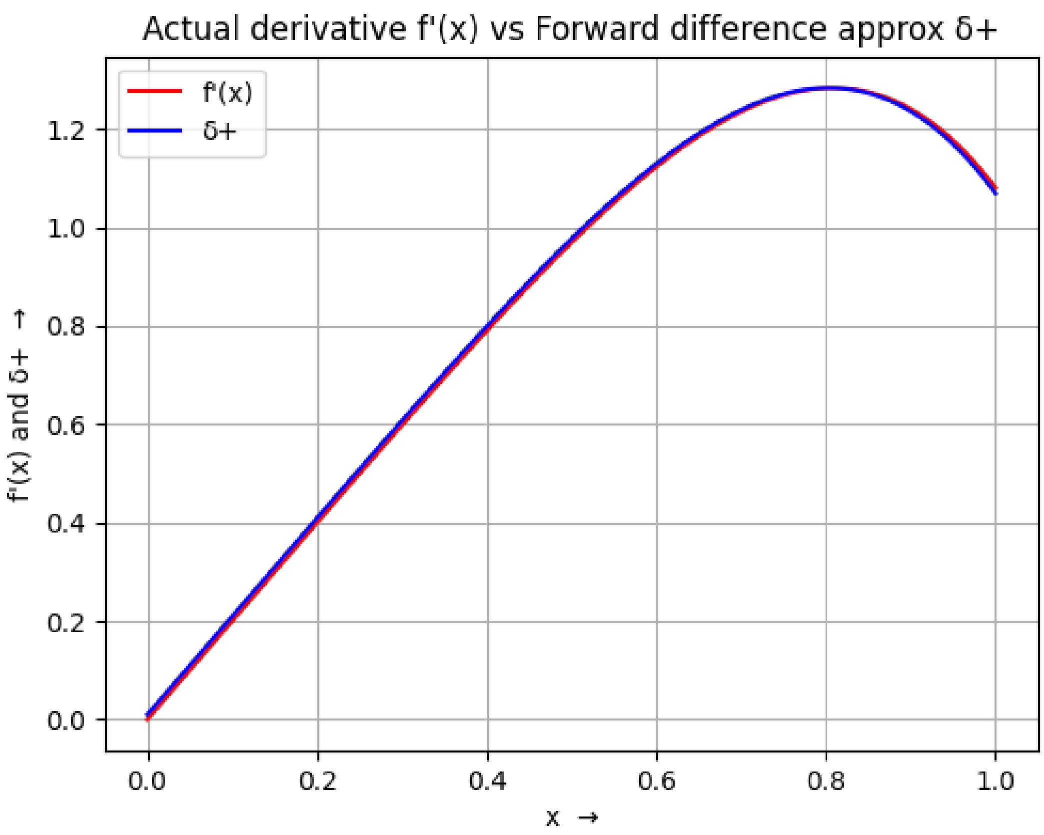
Lab Report

Q1. In this ques we made the following methods:

- *fun* : it returns the value of *sin*(x^2) for a given x (here argument).
- *derv* : it returns the value of derivative of *sin*(x^2) for a given x (here argument).
- *frwd_diff* : it returns the forward finite difference approx for a given x (here argument).
- *graph* : to plot the graph using matplotlib library
- *calculate* : function to calculate all the necessary values and to call the above functions.

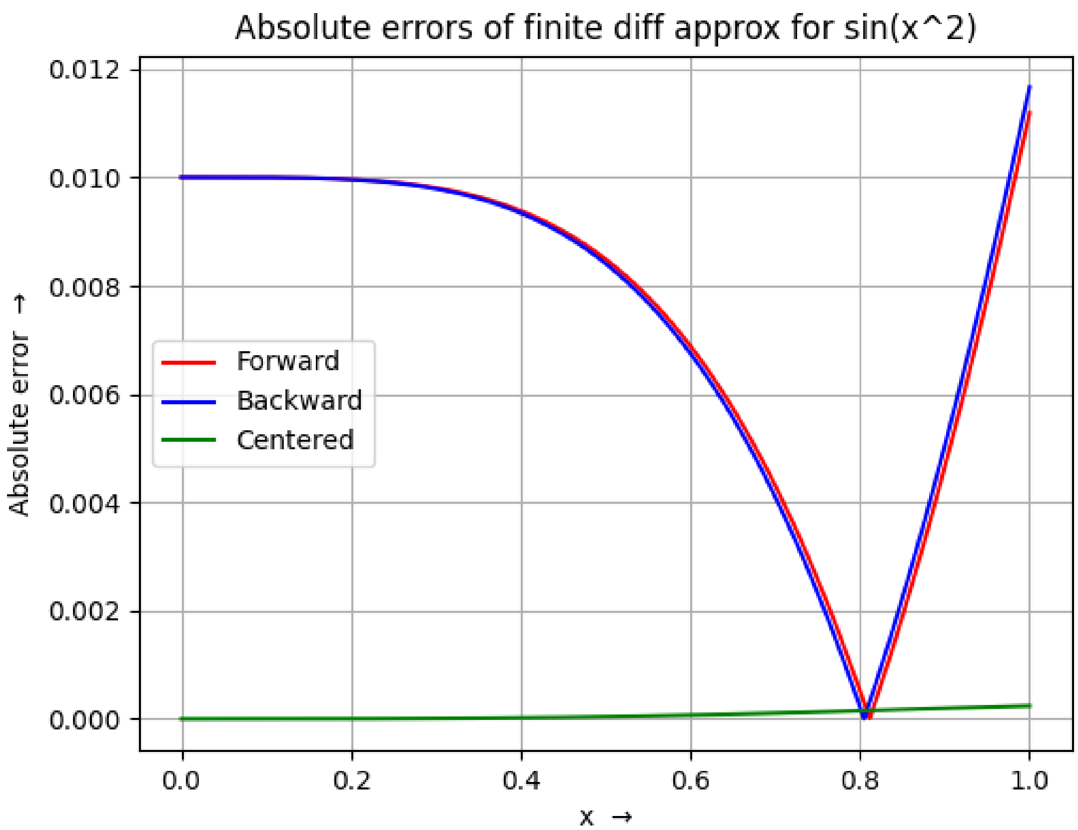
We can just call the calculate function with appropriate parameters to execute the given program.



Q2. In this question we made the following methods:

- *fun* : it returns the value of *sin*(x^2) for a given x (here argument).
- *derv* : it returns the value of derivative of *sin*(x^2) for a given x (here argument).
- *diff* : it returns the forward, backward, centered finite difference approx for a given x (here argument).
- *graph* : to plot the graph using matplotlib library
- *calculate* : function to calculate all the necessary values and to call the above functions.

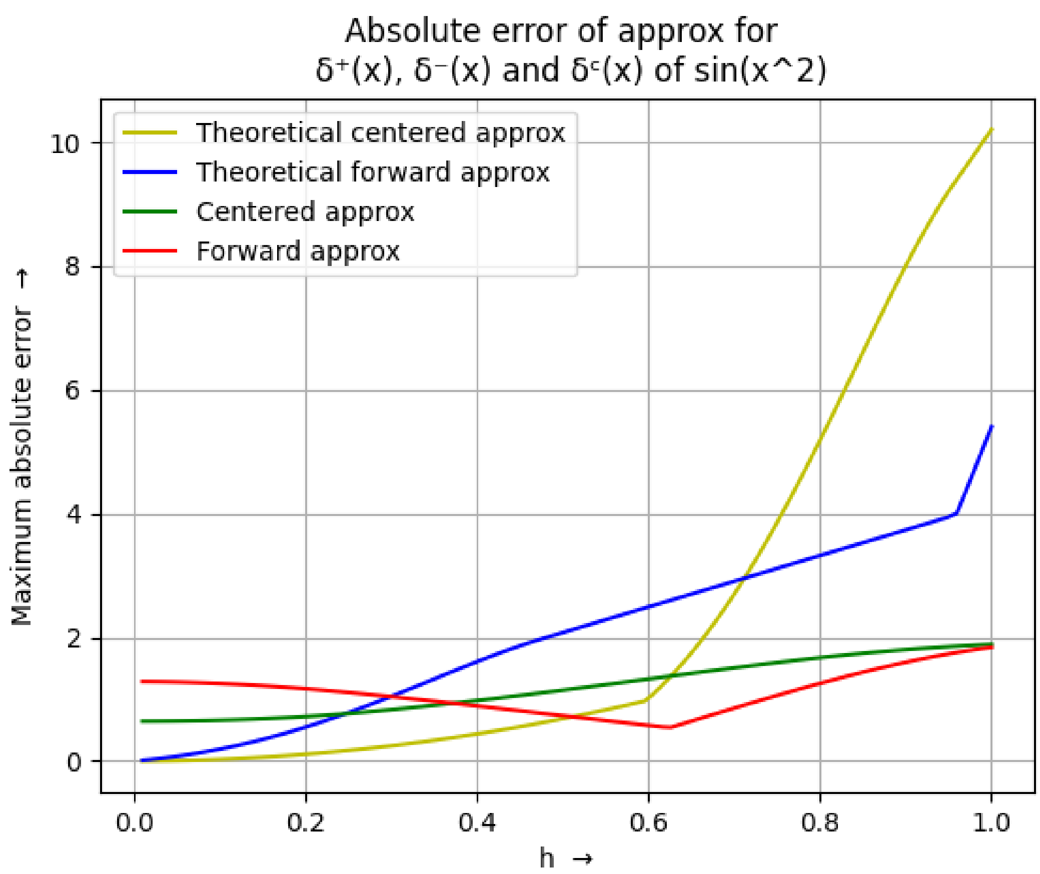
We can just call the calculate function with appropriate parameters to execute the given program.



Q3. In this question we made the following methods:

- *fun* : it returns the value of *sin(x^2)* for a given x (here argument).
- *derv* : it returns the value of 1st derivative of *sin(x^2)* for a given x (here argument).
- *derv2* : it returns the value of 2nd derivative of *sin(x^2)* for a given x (here argument).
- *derv3* : it returns the value of 3rd derivative of *sin(x^2)* for a given x (here argument).
- *cal* : it returns the forward and centered finite difference approx for a given x (here argument).
- *graph* : to plot the graph using matplotlib library
- *calculate* : function to calculate the theoretical maximum absolute error of approx and absolute error of approx and plot the graph of both of them using the above functions.

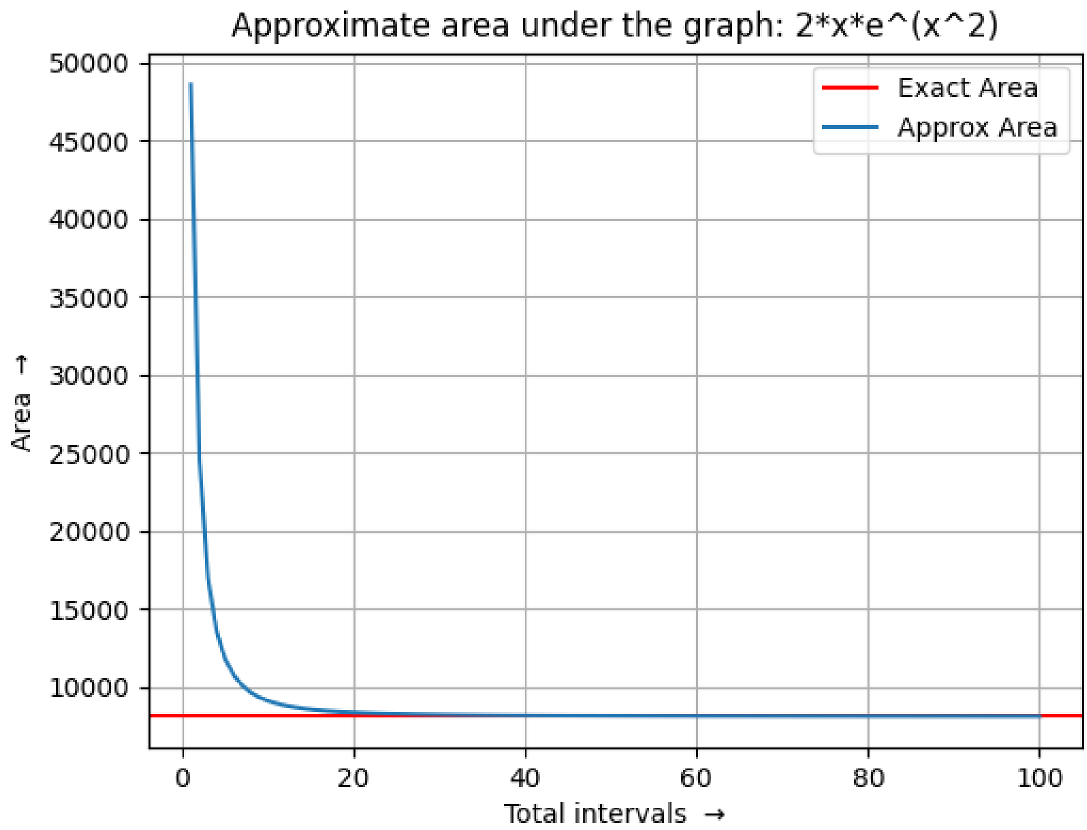
We can just call the calculate function with appropriate parameters to execute the given program.



Q4. In this question we made the following methods:

- *fun* : it returns the value of $2xe^{x^2}$ for a given x (here argument).
- *integration* : it returns the value of $2xe^{x^2}$ integration of for a given x (here argument).
- *graph* : to plot the graph using matplotlib library
- *calculate* : function to calculate all the area under the curve using the trapezoid formula and exact area.

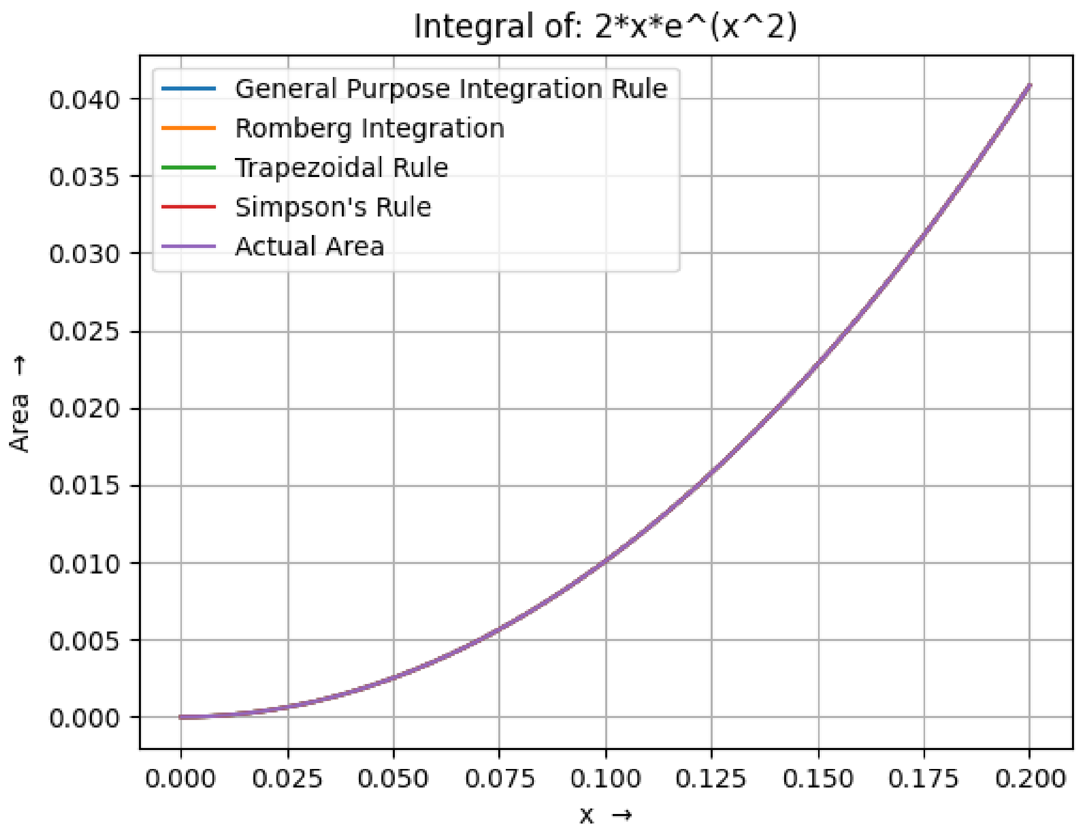
We can just call the calculate function only passing the ***M***(no. of intervals) to execute the program.



Q5. In this question we made the following methods:

- *fun* : it returns the value of $2xe^{x^2}$ for a given x (here argument).
- *integration* : it returns the value of $2xe^{x^2}$ integration of for a given x (here argument).
- *graph* : to plot the graph using matplotlib library
- *calculate* : function to calculate all the area under the curve using the different integration functions under the integrate module of scipy library and the actual area inder the curve.

We can just call the calculate function only by passing the ***u***(upper limit of the interval) to execute the program.



Q6. In this question we need to make some changes in the Polynomal class(from the assignment 3) and add the following methods:

- *derivative* : to return the coefficiects of derivative of the polynomial expression.
- *integral* : to return the coefficients of integral of the polynomial expression.
- *area* : to return the area under the curve for the given iinterval.

Since we need to calculate the integral to for area under the curve, the area method will call the integral method to do that work for it.

Q7. In this question we need to make some changes in the enhanced Polynomal class(from the previous question) and add the following method:

- *integration* : to return the value of integral of $e^x * \ sin(x)$ for a particular point.

Here we are using the Maclaurin series to reduce the given expression to reduce it into its polynomial form and then calculate the area under the curve for this polynomial expression using the above integration method. To achieve this, we need to create an object with the coefficients being the coefficients of the Maclaurin series and do all the further calculation on that object.

To calculate the error, we need to calculate the actual area under the curve and for that we will take the help of area function from the previous question. Atlast we'll subtract the approx area(integration function) from the actual area(area function) to calculate the error which will turn out to be under the lmit of 10^{-6}.