**LIYANAGE D.P**

**E/15/202**

**EM 314 – ASSIGNMENT 4**

**QUESTION 01**

**(a)** function [I] = CompositeTrapezoidalRule(a,b,n)

h = (b-a)./n;

sum = 0;

i = 1;

while i < n

sum = sum + g(a + i\*h);

i = i + 1;

end

I = (h/2)\*(g(a) + 2\*sum + g(b));

display(I);

p = g1(b) - g1(a);

q = g2(b) - g2(a);

r = g3(b) - g3(a);

s = g4(b) - g4(a);

anlt = p - q - 4\*r + 2\*s;

error = ((anlt - I)./anlt)\*100;

display(error);

function t = g(x)

t = 1 - x - 4\*(x.^3) + 2\*(x.^5);

function t = g1(x)

t = x;

function t = g2(x)

t = (x.^2)./2;

function t = g3(x)

t = (x.^4)./4;

function t = g4(x)

t = (x.^6)./6;

**(b)**

|  |  |  |
| --- | --- | --- |
| **Segment** | **Integral** | **Percent Relative Error** |
| 2 | 1852 | -67.5513 |
| 3 | 1447.7 | -30.9759 |
| 4 | 1300 | -17.6116 |

**(c)** function [I] = mulAplicSimpson13rdRule(a,b,n)

h = (b-a)/n;

sumE = 0;

sumO = 0;

i = 1;

j = 2;

while i < n

sumO = sumO+ g(a + i\*h);

i = i + 2;

end

while j < n

sumE = sumE + g(a + j\*h);

j = j + 2;

end

I = (h/3)\*(g(a) + 4\*sumO + 2\*sumE + g(b));

display(I);

p = g1(b) - g1(a);

q = g2(b) - g2(a);

r = g3(b) - g3(a);

s = g4(b) - g4(a);

anlt = p - q - 4\*r + 2\*s;

error = ((anlt - I)./anlt)\*100;

display(error);

function t = g(x)

t = 1 - x - 4\*(x.^3) + 2\*(x.^5);

function t = g1(x)

t = x;

function t = g2(x)

t = (x.^2)./2;

function t = g3(x)

t = (x.^4)./4;

function t = g4(x)

t = (x.^6)./6;

|  |  |  |
| --- | --- | --- |
| **Segments** | **Integration** | **Percent Relative Error** |
| 2 | 1276 | -15.4403% |
| 4 | 1116 | -0.9650% |
| 6 | 1107.4 | -0.1906% |

**(d)**

**(e)**

|  |  |  |
| --- | --- | --- |
| **Segments** | **Error in Composite Trapezoidal Rule** | **Error in Multiplication Application of Simpson’s Rule** |
| 2 | -67.5513% | -15.4403% |
| 3 | -30.9759% | -6.8624% |
| 4 | -17.6116% | -0.9650% |

Since we cannot apply multiple application of Simpson’s 1/3rdrule for 3 segments we apply Simpson’s 3/8thrule.

function [I] = Simpsons38thRule(a,b)

h = (b-a)/3;

I = (3/8)\*(g(a) + 3\*g(a+h) + 3\*g(a + 2\*h) + g(b));

display(I);

p = g1(b) - g1(a);

q = g2(b) - g2(a);

r = g3(b) - g3(a);

s = g4(b) - g4(a);

anlt = p - q - 4\*r + 2\*s;

error = ((anlt - I)./anlt)\*100;

display(error);

As you can see in the table percent relative error of multiple application of Simpson’s rule has the highest convergence rate. It is because although the Simpson’s rule has 3rd accuracy, it has a 4th order polynomial. So at a high convergence rate Simpson’s rule will be converged to zero.

**QUESTION 02**

**(a) (i) – Composite Trapezoidal Rule**

**(ii) – Multiple Application of Simpson’s 1/3rd rule**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Segments** | **(i)** | **(ii)** |
| β(1,2) | 2 | 0.5000 | 0.5000 |
| 3 | 0.5000 | 0.5000 |
| 4 | 0.5000 | 0.5000 |
| β(1.5,2.5) | 2 | 0.1250 | 0.1667 |
| 3 | 0.1571 | 0.1768 |
| 4 | 0.1708 | 0.1860 |
| β(2,3) | 2 | 0.0625 | 0.0833 |
| 3 | 0.0741 | 0.0833 |
| 4 | 0.0781 | 0.0833 |

syms x

f = x\*((1 -x).^2);

anlt = int(f,[0,1]);

syms x

f = (x.^0.5)\*((1-x).^1.5);

anlt = int(f,[0,1]);

syms x

f = 1 - x;

anlt = int(f,[0,1]);

Analytical integration was done by these code segments

**(b)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Segments** | **(i)-percent relative error** | **(ii)-percent relative error** |
| β(1,2) | 2 | 0% | 0% |
| 3 | 0% | 0% |
| 4 | 0% | 0% |
| β(1.5,2.5) | 2 | 36.3380% | 15.1004% |
| 3 | 19.9896% | 9.9565% |
| 4 | 13.0122% | 5.2709% |
| β(2,3) | 2 | 25.0000% | 0% |
| 3 | 11.1111% | 0% |
| 4 | 6.2500% | 0% |

Here I have used Simpson’s 3/8th rule for the calculations of 3 segments.

As you can see in the table percent relative error of multiple application of Simpson’s rule has the highest convergence rate. It is because although the Simpson’s rule has 3rd accuracy, it has a 4th order polynomial. So at a high convergence rate Simpson’s rule will be converged to zero.

**QUESTION 03**

Exact solution is = 0.966105

Percent relative is =