**Assignment: Numerical Differentiation**

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## **Problem**

Estimate the velocity and acceleration from datasets of position of an object.

|  |  |
| --- | --- |
| X |  |
| Y |

**1. Create a function for numerical 1st order differentiation from a set of discrete data**

* With assumption of 3 or more data points, for m dataset

3-Point forward difference: for the first point x[0]

2-Point central difference: for x[1]~x[m-2]

3-Point backward difference: for the last point x[m-1]

* Write down a pseudocode for the function

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| // Your Pseudocode  h = 0.5  // 3-Point forward difference  dydx[0] = (-3y[0]+4y[0]-y[2])/(2h)  // 2-Point central difference  for i = 0 ; I < m-1 ; i++ {  dydx[i]=(y[i+1]-y[i-1])/(2h)  }  // 3-Point backward difference  dydx[m-1] = (y[m-3]-4y[m-2]+3y[m-1])/(2h) |

* Create a function for numerical differentiation from a set of data

void gradient1D (double x[ ], double y[ ], double dydx[ ], int m)

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| // show your output |

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| --- |
| // show your code here  **//** void gradient1D (double x[ ], double y[ ], double dydx[ ], int m){ } |

**2. Create a function for numerical 1st order differentiation from user defined math equation**

* Define a function that defines the target equation.

double myFunc(const double x)

* Create the following function that calls myFunc() to generate dataset and estimate differentiation.

void gradientFunc(double func(const double x), double x[ ], double dydx[ ], int m)

* Check your function with the test equation

“ y=x^3 “ at x=0:0.2:4

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| // show your output |

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| // Code for void gradientFunc() |

**4. Create a function for 2nd order differentiation**

* Create a function for numerical differentiation from a set of data

void acceleration(double x[ ], double y[ ], double dy2dx2[ ], int m)

// First Point: Four-point forward difference (see APPENDIX)

// Mid Points: Three-point central difference

// End Point: Four-point backward difference

* Check your function with the test equation

“ y=x^3 “ at x=0:0.2:4

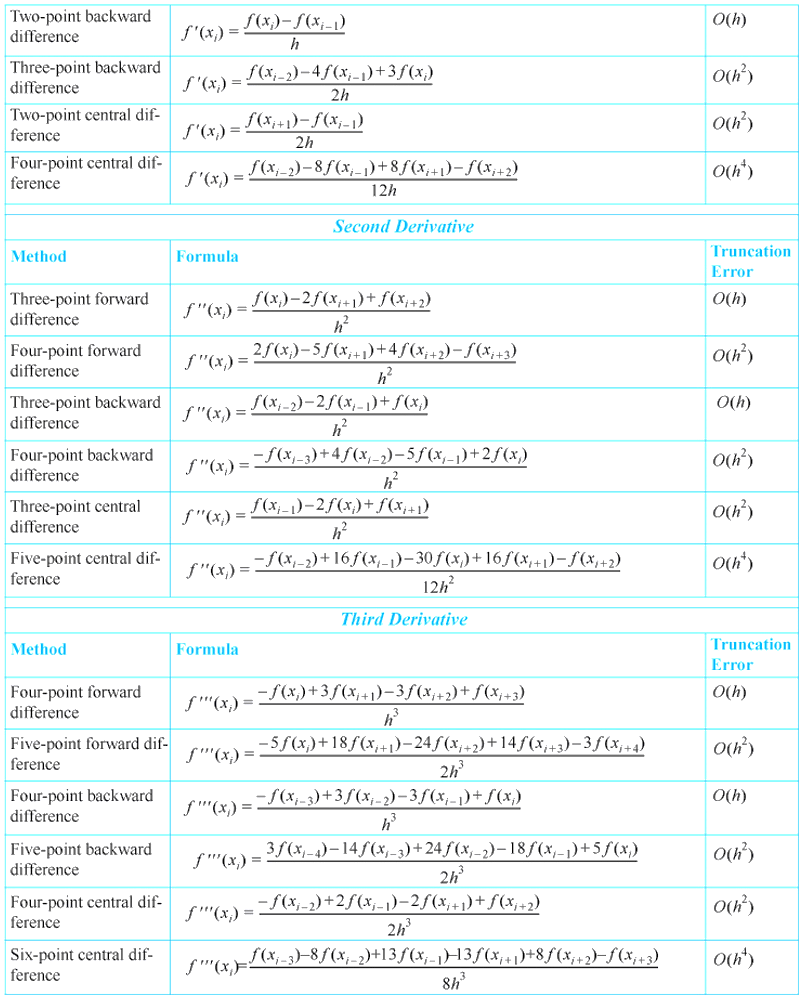
|  |
| --- |
| // show your output |

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| --- |
| // Code for void acceleration () |

**What you need to submit**

* Submit the report+source files as a zip file online (LMS)
* **Report:**  with pseudocode, output result and source code as instructed
* **Src Code:** Assignment\_nonlinear\_Name\_ID.cpp, myNP.h, myNP.cpp
* All the functions you have created should be updated in myNP.h and myNP.cpp

**Appendix**

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