Islamic University Faculty of Computer and Information Systems		الجامعة الإسلامية كلية الحاسب الآلي ونظم المعلومات

Numerical Computing Methods
Assignment (3)

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Grade

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1. Apply Gauss's forward formula to find the value of $f(x)$ at $x = 3.75$ from the table:

x:	2.5	3.0	3.5	4.0	4.5	5.0
$f(x)$:	24.145	22.043	20.225	18.644	17.262	16.047.

$a = 3.5$, $h = 0.5$, $u = 0.5$, $x = 3.75$

p	x	$f(x)$	$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$	$\Delta^4 f(x)$	$\Delta^5 f(x)$
-2	2.5	24.145					
			-2.102				
-1	3.0	22.043		0.284			
			-1.818		-0.047		
0	3.5	20.225		0.237		9×10^{-3}	
			-1.581		-0.038		-3×10^{-3}
1	4.0	18.644		0.199		6×10^{-3}	
			-1.382		-0.032		
2	4.5	17.262		0.167			
			-1.215				
3	5.0	16.047					

$$f(u) = f(0) + u\Delta f(0) + \frac{u(u-1)}{2!}\Delta^2 f(-1) + \frac{(u+1)u(u-1)}{3!}\Delta^3 f(-1) + \dots + \frac{(u+1)u(u-1)(u-2)\dots(u-n)}{n!}$$

$$f(3.75) = (20.225) + (0.5)(-1.581) + \frac{(0.5)(0.5-1)}{2!}(0.237) + \frac{(0.5+1)(0.5)(0.5-1)}{3!}(-0.038) +$$

$$\frac{(0.5+1)(0.5)(0.5-1)(0.5-2)}{4!}(9\times10^{-3}) + \frac{(0.5+1)(0.5+2)(0.5)(0.5-1)(0.5-2)}{5!}(-3\times10^{-3})$$

$$= 20.225 + (-0.7905) + (-0.0296) + (2.385\times10^{-3}) + (2.1093\times10^{-4})$$

$$= \boxed{19.407}$$

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3. Find the value of $f(41)$ by applying Gauss's forward formula from the following data:

x:	30	35	40	45	50
$f(x)$:	3678.2	2995.1	2400.1	1876.2	1416.3

$a = 40$, $h = 5$, $u = 0.2$, $x = 41$

p	x	$f(x)$	$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$	$\Delta^4 f(x)$
-2	30	3678.2				
			-683.1			
-1	35	2995.1		88.1		
			-595		-17	
0	40	2400.1		71.1		9.9
			-523.9		-7.1	
1	45	1876.2		64		
			-459.9			
2	50	1416.3				

$$f(u) = f(0) + u\Delta f(0) + \frac{u(u-1)}{2!}\Delta^2 f(-1) + \frac{(u+1)u(u-1)}{3!}\Delta^3 f(-1) + \frac{(u+1)u(u-1)(u-2)}{4!}\Delta^4 f(-2)$$

$$f(41) = (2400.1) + (0.2)(-523.9) + \frac{(0.2)(0.2-1)}{2!}(71.1) + \frac{(0.2+1)(0.2)(0.2-1)}{3!}(-7.1) +$$

$$\frac{(0.2+1)(0.2)(0.2-1)(0.2-2)}{4!}(9.9)$$

$$= 2400.1 + (-104.78) + (-5.688) + 0.2272 + 0.14256$$

$$= \boxed{2290.001}$$

5. From the following table find y when $x = 1.45$

x:	1.0	1.2	1.4	1.6	1.8	2.0
y:	0.0	−.112	−.016	.336	.992	2.0

$a = 1.4$, $h = 0.2$, $u = 0.25$, $x = 1.45$

p	x	f(x)	Δf(x)	Δ²f(x)	Δ³f(x)	Δ⁴f(x)	Δ⁵f(x)
-2	1.0	0.0					
			-0.112				
-1	1.2	-0.112		0.064			
			-0.048		0.48		
0	1.4	-0.16		0.544		-0.864	
			0.496		-0.384		1.44
1	1.6	0.336		0.16		0.576	
			0.656		0.192		
2	1.8	0.992		0.352			
			1.008				
3	2.0	2.0					

$$f(u) = (-0.16) + (0.25)(0.496) + \frac{(0.25)(0.25-1)}{2!}(0.544) + \frac{(0.25+1)(0.25)(0.25-1)}{3!}(-0.384)$$

$$+ \frac{(0.25+1)(0.25)(0.25-1)(0.25-2)}{4!}(-0.864) + \frac{(0.25+2)(0.25+1)(0.25)(0.25-1)(0.25-2)}{5!}(1.44)$$

$$= (-0.16) + 0.124 + (-0.051) + 0.015 + (-0.01476) + 0.011074$$

$$= \boxed{-0.075}$$