**MATLAB Quiz**

**Spring 2015**

**Version 2**

Exercise1:

a. Given the arrays {(x(i),y(i))| i=1,2,…,n}, $n\geq 2$ with x(i+1)-x(i)=h, for all I,write the MATLAB function that computes:

$\left(1\right) T=T\left(h\right)=\frac{h}{2}(y\_{1}+2\left(y\_{2}+y\_{3}+…+y\_{n-1}\right)+y\_{n})$.

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| function T= SumTrap(x,y)% Inputs: x,y: 2 vectors of the same length% Output: The above value T given by (1)h=x(2)-x(1);n=length(y);T=y(1);for i=2:n-1 T=T+2\*y(i);endT=T+y(n);T=T\*0.5\*h;% Find T end |

Based on the arrays {(x(i),y(i)| i=1,2,…,n} with n=2k+1, $k\geq 1$ and let h0=x(n)-x(1), consider the array {T(h0),T(h0/2),…,T(h0/2k)} and consequently:

$ \left(2\right) \left\{\begin{array}{c}R^{1}\left(h\right)=\frac{4T\left(h\right)-T(2h)}{3}, h=\frac{h\_{0}}{2},…,\frac{h\_{0}}{2^{k}}\\R^{j}\left(h\right)=\frac{4^{j}R^{j-1}\left(h\right)-R^{j-1}\left(2h\right)}{4^{j}-1},h=\frac{h\_{0}}{2^{j}},…,\frac{h\_{0}}{2^{k}}\end{array}\right.$.

Now write the MATLAB function that implements the above formulae (2) and outputs the array T and the lower triangular matrix R of size$ k×k$.

Call for the previous function if needed.

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| function [T,R]=Richard(x,y,k)% Inputs: x,y: 2 vectors of length 2k+1% k:integer. % Output: T: a vector of length k+1% R: a lower triangular matrix of size k×k as given in(2)T=zeros(k+1,1);R=zeros(k,k);% You will need to generate a column vector h of length k+1 with % h(1)=x(n)-x(1) and h(i)=h(i-1)/2function [ T R] = richard( x,y,k )n=length(y);h=[];T=[];R=[];h0=x(n)-x(1);for i=1:k h=[h h0/(power(2,i))]endfor j=1:k T=[T sumtrap(x,y)\*(2/(x(2)-x(1)) \*h(j))]end for l=1:kfor m=l:k R=[R (4T(m)-T(2m))/3]endR=[R power(4,l)\*R(l)-R(2l)]end%%the variable l goes from 1 to k because the first column is full , the%%variable m goes from l to k because the first row of the second column is%%empty the first two row of the third too...     end |

Test the function **Richard** using the following inputs:

x=linspace(0,3,5), and y={y(1),…,y(5)} such that y(i)=sin ((x(i))2).

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| %copy the commands you used and the results T and R in this spaceT=R= |

Exercise 2:

Let $f(x)$ be the function defined by the following series:

$f\left(x\right)=t\_{1}\left(x\right)+t\_{2}\left(x\right)+…+t\_{n-1}\left(x\right)+t\_{n}\left(x\right)+…=\sum\_{i=1}^{\infty }t\_{i}(x)$, for all x

with:

$$\left\{\begin{array}{c}t\_{1}\left(x\right)=\frac{x}{2}\\t\_{n}\left(x\right)=\frac{\left(-1\right)^{n-1}}{\left(n-1\right)!n!}(\frac{x}{2})^{2n-1},n\geq 2\end{array}\right.$$

Express $t\_{n}\left(x\right)$ as a function of $t\_{n-1}\left(x\right)$ by finding $a\_{n}(x)$ such that:

$$t\_{n}\left(x\right)=a\_{n}(x)t\_{n-1}\left(x\right),n\geq 2$$

Use the above relation in writing the MATLAB function **T(x,p)** to approximate f(x) up to a precision **p**, described below.

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| function [t,N,y]=T(x,p)% Input: x a number% p an integer >=2% Output:N: least integer such that $\left|t\_{N}(x)\right|\leq 0.5\*10^{1-p}$% t: array$ [t\_{1},t\_{2},…,t\_{N}]$% y:approximation to f(x)function [ t,N,y ] = ex2( x,p )t=[x/2];i=1;while t(i)>0.5\*power(10,1-p) t=[t (formula)] endf=f+t(i)End |

Test the function **T(x,p)** using x=1 and p=3,7,10. The results should be expressed in double precision.

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| **P** | **T(x,p)** |
| 3 |  |
| 7 |  |
| 10 |  |