Dr. Leon VanDommelen,
Exam 2, 11/08/18, Question 1

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IMPORTANT:

DO NOT CHANGE **ANYTHING** IN THIS FILE! Just create script solvesys.m (lowercase) and then run this script to test it.

Initialize

```
format compact
more off
```

Run script solvesys.m

```
disp(' ')
disp('-------------------------------------------------')
disp('try n = 3:')
n=3
solvesys

disp(' ')
disp('-------------------------------------------------')
disp('try n = 6:')
n=6
solvesys
```

```
-------------------------------------------------
try n = 3:
n =
     3
A =
     1     2     0
     1     0     4
     0     0     1
b =
     0
     2
     0
condA =
   20.0184
```

```
x =
     2
    -1
     0

------------------------------------------------
try n = 6:
n =
     6
A =
     1     2     0     0     0     0
     1     0     4     0     0     0
     0     1     0     4     0     0
     0     0     1     0     4     0
     0     0     0     1     0     4
     0     0     0     0     0     1
b =
     0
     2
     3
     4
     5
     0
condA =
  177.0559
x =
    34
   -17
    -8
     5
     3
     0
*** May have an error of 18%
```

Additional m-File: solvesys.m

```
% relative error in the data
relErrData=0.001;

% initialize the matrix
A=zeros(n);
b=zeros(n,1);

% set row i = 1
A(1,1)=1;
A(1,2)=2;

% set rows i = 2 to n-1
for i=2:n-1
    A(i,i-1)=1;
    A(i,i+1)=4;
```

```
    b(i)=i;
end

% set the final row
A(n,n)=1;

% show
A=A
b=b

% check condition number
condA=cond(A)
if condA*eps(1)>0.1
    disp('*** No reasonable solution possible.')
else
    x=A\b
    relErrSol=condA*relErrData;
    if relErrSol>0.05
        fprintf('*** May have an error of %.0f%%\n',...
                relErrSol*100)
    end
end
```

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Dr. Leon VanDommelen,
Exam 2, 11/08/18, Question 2

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IMPORTANT:

Do not change **anything** in this header! Put the solution to the question completely at the end of the file.

Initialize

```
format compact
more off
```

My Solution:

```
% set the worst case x
x=1-1/sqrt(2);

% maximum number of terms we will ever sum
iMax=500;

% initialize the sum to the first term
ti=x;
total=ti;

% add more terms until the sum no longer improves
for i=2:iMax
    % compute the new term from the previous value
    ti=ti*x*((i-1)/i);
    % remember the current sum
    totalOld=total;
    % add the new term
    total=total+ti;
    % if no change, stop summing
    if total==totalOld
        break
    end
end
if total~=totalOld
    disp('*** WARNING: Sum did not converge!')
end

% analyze the results
exact=log(sqrt(2));
```

```
fprintf('Total number of terms summed: %i\n',i)
fprintf('The obtained value is %.16f\n',total)
fprintf('The "exact"  value is %.16f\n',exact)
fprintf('The difference between the two is %.1E\n',...
        total-exact)
```

```
Total number of terms summed: 29
The obtained value is 0.3465735902799727
The "exact"  value is 0.3465735902799727
The difference between the two is 0.0E+00
```

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Dr. Leon VanDommelen,
Exam 2, 11/08/18, Question 3

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IMPORTANT:

Do not change **anything** in this header! Put the solution to the question completely at the end of the file.

Initialize

```
format compact
more off
```

My Solution:

```
% Find the partial fraction expansion of a ratio
disp('Analyze a Laplace transform:')
disp(' ')
syms s
ratSym=(s^3+s^2+s+1)/(s^4-2*s^3-14*s+15)
disp(' ')
factors=prod(factor(ratSym))
disp(' ')
partFrac=partfrac(ratSym)
disp(' ')

% Find the roots of the lemniscate
disp('Roots of the lemniscate:')
syms x y
disp(' ')
ySol=solve((x^2+y^2)^2==x^2-y^2,y)
disp(' ')

% integrate a function
disp('Antiderivative of a function:')
syms a x
disp(' ')
f=1/sqrt(a^2-x^2)
disp(' ')
F=int(f,x)
disp(' ')
valSym=subs(F,{a x},{1 1/sqrt(2)})
disp(' ')
FNum=matlabFunction(F)
```

```
disp(' ')
valNum=FNum(1,1/sqrt(2));
fprintf('valNum=\n%.32f\n',valNum)
valSym32=vpa(valSym,32)
```

```
Analyze a Laplace transform:

ratSym =
-(s^3 + s^2 + s + 1)/(- s^4 + 2*s^3 + 14*s - 15)

factors =
((s^2 + 1)*(s + 1))/((s - 1)*(s - 3)*(s^2 + 2*s + 5))

partFrac =
1/(s - 3) - 1/(4*(s - 1)) + (s/4 + 3/4)/(s^2 + 2*s + 5)

Roots of the lemniscate:

ySol =
  (- x^2 - (8*x^2 + 1)^(1/2)/2 - 1/2)^(1/2)
    ((8*x^2 + 1)^(1/2)/2 - x^2 - 1/2)^(1/2)
 -(- x^2 - (8*x^2 + 1)^(1/2)/2 - 1/2)^(1/2)
   -((8*x^2 + 1)^(1/2)/2 - x^2 - 1/2)^(1/2)

Antiderivative of a function:

f =
1/(a^2 - x^2)^(1/2)

F =
atan(x/(a^2 - x^2)^(1/2))

valSym =
pi/4

FNum =
    @(a,x)atan(x.*1.0./sqrt(a.^2-x.^2))

valNum=
0.78539816339744828000000000000000
valSym32 =
0.78539816339744830961566084581988
```

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