

## MATLAB Exercise 5 – Symbol Computation

1. Compare the following commands, and show the data types and values of a1, a2, a3 and a4.

```
>> a1=1/4+1/6
>> a2=sym(1/4+1/6)
>> a3='1/4+1/6'
>> a4='1/4+1/6'; eval(a4)
```

2. Input following commands, try to compare and analysis the results.

- 1) a) `>> clear; c1= a+2*a; c1`
- 2) a) `>> clear; c3='a+2*a'; eval(c3)`  
b) `>> clear; c4=' a+2*a'; a=3; eval(c4)`
- 3) a) `>> clear; syms a; c5=' a+2*a'; eval(c5)`  
b) `>> clear; syms a; c6= a+2*a; eval(c6)`  
c) `>> clear; syms a; c7=sym('a+2*a'); subs(c7, a, 2)`  
d) `>> clear; syms a; c8=sym('a+2*a'); subs(c8, 2)`
- 4) a) `>> clear; c9=sym(' a+2*a+b'); c9`  
b) `>> clear; c10=sym('a+2*a+b'); subs(c10, 1)`  
c) `>> clear; c11=sym(' a+2*a+b'); subs(c11, a, 1)`  
d) `>> clear; syms a; c12=sym('a+2*a+b'); subs(c12,a,1)`  
e) `>> clear; syms a b; c13=sym('a+2*a+b'); subs(c13,a,1, b,2)`  
f) `>> clear; syms a b; c14=sym('a+2*a+b'); subs(c14, [a,b], [1, sym('pi')])`

3. Let  $f = x^3 - 6x^2 + 11x - 6$ ,  $g = (x-1)(x-2)(x-3)$ ,  $h = x[x(x-6)+11]-6$ . Please use function `factor`, `horner`, `expand` to prove the following conclusion:

- 1)  $f$  is the expanded form of  $g$  and  $h$
  - 2)  $g$  is the factor form of  $f$
  - 3)  $h$  is the nested form of  $f$
4. Please simply the following functions by using `simple`, `simplify` and `pretty` respectively

$$1) \sqrt[3]{\frac{1}{x^3} + \frac{6}{x^2} + \frac{12}{x} + 8}$$

$$2) \cos x + \sqrt{-\sin^2 x}$$

$$3) \frac{1}{x+1} + \frac{1}{x-1}$$

$$4) e^{c \ln \sqrt{a+b}}$$

$$5) \frac{\sin 2\alpha \sin \alpha \cos \alpha}{(1+\cos 4\alpha)(1+\cos \alpha)(1-\cos \alpha)}$$

$$6) \cos 4\alpha - 4 \cos 2\alpha + 3$$

**Help** in command window input `help simple` (and `simplify`), understand the effect of these function.

5. Let s express the symbolic expression  $a \sin(x) + e^y$ . Use `subs` function to compute the

following expressions, and simply the results.

1)  $a \sin(x) + e^{\ln t}$       2)  $a \sin\left(\frac{\pi}{3}\right) + 1$

6. Set  $p = a + xy + 2xy^2 + 3x^2y$ . Please use `collect` function to

- 1) collects all the coefficients with the same power of  $x$
- 2) views  $p$  as a polynomial in its symbolic variable  $y$

7. Use `randn` function to generate a random  $2 \times 2$  matrix  $A$ . Substitute a matrix  $A$  into the symbolic expression  $3x^2 - 2x + 5$ .

8. Set symbolic expression  $f(x) = e^{-x}$ . Please compute the value of

- 1)  $f(0)$
- 2)  $f(\text{eps})$
- 3)  $f(1), f(2), f(3), \dots, f(20)$

9. Generate two symbolic matrices  $s\_a = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, s\_b = \begin{bmatrix} u & v \\ s & t \end{bmatrix}$ , compute

- |                             |                          |                  |
|-----------------------------|--------------------------|------------------|
| 1) $s\_a + s\_b$            | 2) $2 * s\_a$            | 3) $s\_a * s\_b$ |
| 4) $s\_a . * s\_b$          | 5) $s\_a \setminus s\_b$ | 6) $s\_a / s\_b$ |
| 7) $s\_c = s\_a + i * s\_b$ | 8) $s\_c'$               | 9) $s\_c .'$     |
| 10) $\det(s\_a)$            | 11) $\text{inv}(s\_a)$   |                  |

10. Let  $a$  be  $2 \times 2$  matrix,  $b$  be a symbolic matrix  $b = \begin{bmatrix} 1 \\ x \end{bmatrix}$ . For the following coefficient matrices  $a$ , solve the linear equations  $ax=b$ .

1) $a = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$	2) $a = \begin{bmatrix} 1 & 2 \\ 3 & 6 \end{bmatrix}$	3) $a = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$
4) $a = \begin{bmatrix} 1 & 2 \\ 3 & c \end{bmatrix}$	5) $a = \begin{bmatrix} c & d \\ e & f \end{bmatrix}$	6) $a = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \end{bmatrix}$

11. For the following matrix  $a$ , compute the eigenvalues and eigenvectors of  $a$ .

1) numeric matrix $a = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$	2) symbolic matrix $a = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$
3) symbolic matrix $a = \begin{bmatrix} 1 & x \\ 3 & 4 \end{bmatrix}$	4) symbolic matrix $a = \begin{bmatrix} s & t \\ u & v \end{bmatrix}$

12. For the matrices as Ex11, compute their lu, schur, svd decompositions respectively.