Theoretische Elektrotechnik
Universität Paderborn

Modeling and Simulation: Matlab Fundamentals

return: 16.04.2015 6:00AM (20 points)

Create a script file (m-file) with the following Matlab commands:

1. **Vector and matrix manipulations (7P):**

   (a) Get help on command "zeros".

   (b) Get help on command "ones".

   (c) Get help on command "rand".

   (d) Define 1×5 (1-row and 5-columns) vector a with all elements equal to 0.

   (e) Define 3×1 (3-rows and 1-column) vector a with all elements equal to 1.

   (f) Define 1×5 vector a with elements equal to $1, 2, 3, 4, \pi$, correspondingly.

   (g) Define 3×1 vector a with elements equal to $0.1, 0.2, 0.3$, correspondingly.

   (h) Define 1-row vector a with the elements' values from 3 to 27 with step 3 by using operator ":".

   (i) Define 1-row vector a of 10 linearly equally spaced points between x_1 and x_2, where x_1 and x_2 are the first and last numbers of your student id (use *linspace* function).

   (j) Define 3×3 matrix a of random number elements.

   (k) Define 3×2 matrix $a = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}$.

   (l) Check the size of the matrix a.

   (m) Define 3×3 matrix $a = \begin{pmatrix} 1 & 20 & 30 \\ 40 & 50 & 60 \\ 70 & 80 & 90 \end{pmatrix}$.

   (n) Transpose the matrix a.

   (o) Show (print on display) the element a_{32} of the transposed matrix a.

   (p) Show (print on display) the second row of the transposed matrix a.

   (q) Show (print on display) the third column of the transposed matrix a.

   (r) Define matrix $a = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$ and $b = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$.

   (s) Sum matrices a and b, $c = a + b$.

   (t) Multiply matrices a and b, $c = a * b$.

   (u) Multiply matrices a and b element-by-element, i.e. $c_{ij} = a_{ij} * b_{ij}$.

   (v) Solve the linear system of equations $ax = b$ by using *inv()* function, if $a = \begin{pmatrix} 3 & 1 & 1 \\ 1 & 3 & 1 \\ 1 & 1 & 3 \end{pmatrix}$ and $b = \begin{pmatrix} 8 \\ 10 \\ 12 \end{pmatrix}$.

   (w) Solve the same system by using operator \.

2. **Data analysis functions (4P):**
   (a) Calculate the square root of your student id.
   (b) Define the 1-row vector $a(11, 7, 32, 34, 13, your\_student\_id\_number)$.
   (c) Get the value of the last element of vector a by using the special "*end*" operator.
   (d) Get the part of array a starting from 3rd index by using ":" and "*end*" operators.
   (e) Find minimum value of the vector a.
   (f) Find maximum value of the vector a.
   (g) Calculate the mean value of the vector a.
   (h) Make summation of elements of the vector a.
   (i) Calculate the square roots of all elements of the vector a.
   (j) Sort the vector a in the ascending order a.
   (k) Find the roots of the polynomial equation $x^4 + 4x^3 - 5x^2 + 6x - 9 = 0$.

3. **Making complex numbers (1P):**
   (a) Make a complex number $a = 2 + 3 * i$.
   (b) Get the real part of a.
   (c) Get the imaginary part of a.
   (d) Get the complex conjugate of a.
   (e) Get the value of complex number i.

4. **Plotting Tools (2P):**
   (a) Get help on command "plot".
   (b) Plot the graph of $y = exp(x)$, for $-2\pi \leqslant x \leqslant 2\pi$.
   (c) Plot the graph of $y = log(x)$, for $0 < x \leqslant 2\pi$.

5. **Matlab functions (6P):**
   Write the matlab function (m-file) that a) creates the square matrix a of the size $n \times n$ with all diagonal elements equal to 3 and all other elements equal to 1 (you may use *diag* and *ones* functions) and vector b of size n with elements $b_i = \sum_{j=1}^{n} j * a_{ij}$, b) solve the linear system of equations $ax = b$. The function takes one input parameter - n, and output is the solution vector - x. Run the code for n equal to last number of your student id, if this number is equal to 0 or 1 use the number before, etc. Copy the code of the program and obtained values of the vector x at the end of the script file (where the commands from sections $1 - 4$ are defined).

Instructions for the submission:

1. When submitting your homework, make sure that you have compressed file(s) into a single "zip" or "rar" file with name "ex_1_your_student_id.rar" or "ex_1_your_student_id.zip".