CSC 202
Computational Mathematics with MATLAB

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Course Outline

- Course Description
- Course Objectives
- Class policies
- Assessment

Weekly schedule

Topics
1. Introduction to computational Mathematics, Basics of MATHLAB
2. Vectors and Matrices
3. Plotting and Graphics
4. Statistics and data processing in MATLAB
5. Solving Algebraic Equations
6. Introduction to programming in MATLAB; LOOPS
7. Errors and Pitfalls, debugging
8. Simulation
9. Introduction to Numerical Methods
10. Solution to systems of linear Equations
11. Gaussian Elimination
12. Gauss Jordan Reduction
13. Gauss- Seidel iteration, Successive Over Relaxation

Computational Mathematics [CM]

- Is the branch of Mathematics which is concerned with ways of finding approximate numerical solutions to difficult problems through the use of computers

- It uses a combination of computing tools and mathematical analysis to model and solve important application problems

Computational Mathematics [CM] cont

- In CM, we make use of algorithm design, numerical methods and simulation to create innovative and efficient solutions to difficult applied problems

- CM helps in solving complex interdisciplinary problems in fields such as physics, chemistry, aviation, business, finance, medicine, product design and economics.

Computational Mathematics [CM] cont

- The use of data sets, graphic images and formulas to describe experimental results by scientists and engineers make the study of CM very important as they are equipped with knowledge and skills of the efficiency, accuracy and stability of numerical computations using computers (MATLAB)

Computational Mathematics [CM] cont

- MATLAB provides a technical computing environment designed to support the implementation of computational tasks.
- It is used for programming, 2D and 3D graphing, data analysis and matrix manipulation
- It is interactive and enables numerical computation and data visualization

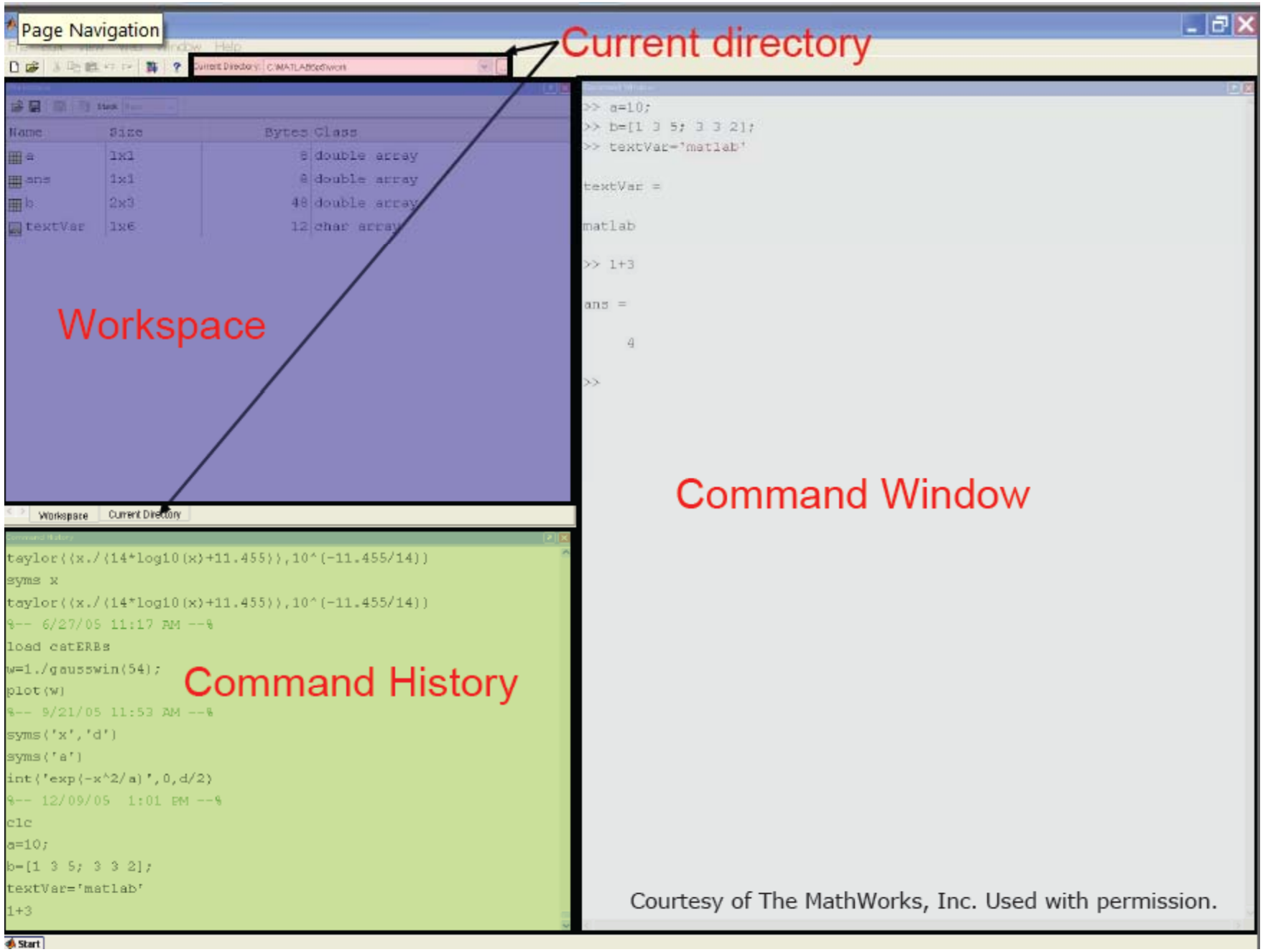
MATLAB

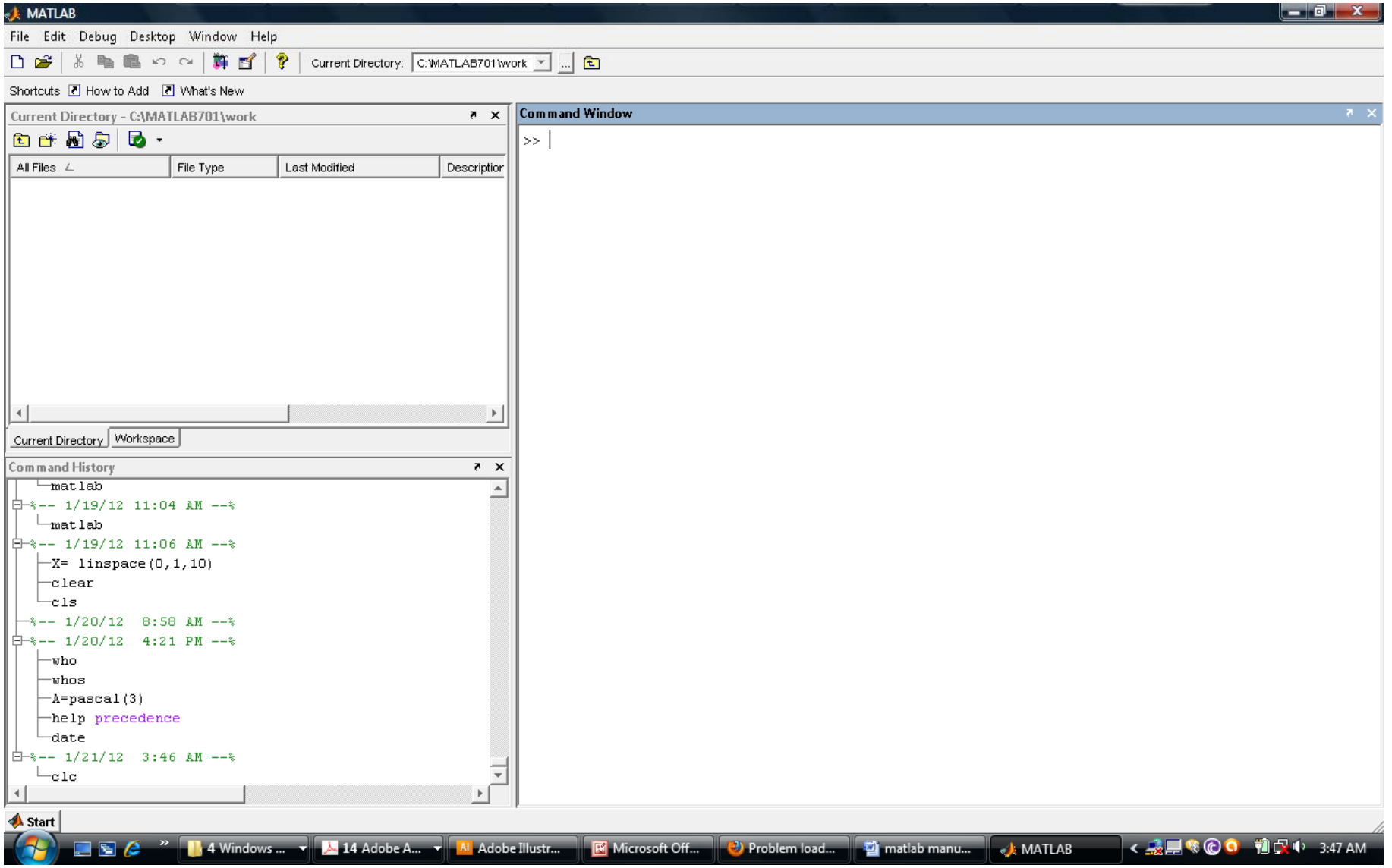
- Is a state of the art mathematical software package, which is used extensively in both academia and industry.
- It is interactive for numerical computation and data visualization, which along with its programming capabilities provide a very useful tool for almost all areas of sciences and engineering.

The Basics of MATLAB

The User Interface

- Matlab's user interface is partitioned into different sub-windows. The most important parts of the user interface are:
  - The command window
  - The workspace
  - The current directory browser
  - The command history


Page Navigation
Current directory
Workspace
Command Window
Command History
Courtesy of The MathWorks, Inc. Used with permission.


MATLAB
File Edit Debug Desktop Window Help
Current Directory: C:\MATLAB701\work
Shortcuts How to Add What's New
Current Directory - C:\MATLAB701\work
All Files
File Type
Last Modified
Description
Current Directory
Workspace
Command History
matlab
%-- 1/19/12 11:04 AM --%
matlab
%-- 1/19/12 11:06 AM --%
X= linspace(0,1,10)
clear
cls
%-- 1/20/12 8:58 AM --%
%-- 1/20/12 4:21 PM --%
who
whos
A=pascal(3)
help precedence
date
%-- 1/21/12 3:46 AM --%
clc
Command Window
>>
Start
4 Windows ...
14 Adobe A...
Adobe Illustr...
Microsoft Off...
Problem load...
matlab manu...
MATLAB
3:47 AM

Making Folders

- It is important to use folders to keep your programs organized
- Click the ‘Make New Folder’ button, and change the name of the folder. **Do NOT use spaces in folder names.**
- The current directory is now the folder you just created

Numbers and Variables

- Number Representation

Variables

- Data are stored in Matlab's working memory as variables
- A variable is a reserved(place) in computer's memory that can be referenced with a unique name.
- A variable can contain various kinds of data. This means that a variable is of a certain data type. Examples of data types: simple numbers, matrices, character sequences (strings).

Variables cont.

- Variables are broadly classified in MATLAB as scalars, vectors, and arrays.

Variable naming Conventions

- A variable is identified by a unique name. the name has to begin with a letter (upper or lower case), after that it can contain further letters, numbers, or underscore. E.g., **X12, rate_const, Flow_rate**
- Variable names are case sensitive.

E.g., **FLOW, flow, Flow, FlOw are all different variables**

The Basics of MATLAB cont'

- To begin with, Type any operation on two or more number in the command window ;
- E.g., >> 7 + 8 <CR>

  ans =

  15

  The answer to the typed command is given the name **ans**. The **ans** is now a variable that we can use again

The Basics of MATLAB

- Example,

  >> ans * 20

  ans =

  300

  Note

  – that MATLAB has updated the value of **ans**

  – Spacing of operators in formulas do not matter

  e.g., 6+4*5-6/3*6 = 6 + 4 * 5 – 6 / 3 * 6

Basic Mathematical Computations

- **Operations**
  - An m-file environment has all the standard arithmetic operations(addition, subtraction etc) and functions (sine, cosine, logarithm etc)
  - Given that X and Y are scalars:

Some common Mathematical Operations

Operation	M-file
X + Y	X + Y
X - Y	X - Y
XY	X*Y
X/Y	X/Y
X^y	X ^y
e^x	exp(x)
$\log_{10}(x)$	log10(x)
ln(x)	log(x)
$\log_2(x)$	Log2(x)
Cos(x)	Cos(x)
Sin(x)	Sin(x)
$\sqrt{x}$	Sqrt(x)

Expressions

- Expressions are formed from numbers, variables and operations

- The operations have different precedence.

  Recall: BEDMAS

Expressions cont’

- Examples

Expression	MATLAB Expression	Computed value
$5^2 + 6^2$	5 ^ 2 + 6 ^ 2	61
$(5+6)^2$	(5 + 6)^2	121
$\frac{2+3}{4-5}$	(2 + 3) / (4 - 5)	-5
$\log_{10}(100)$	log10(100)	2
$\ln(4(2+3))$	log(4 * (2 + 3))	2.9957

Expressions cont’

Note:

- A semicolon added at the end of a line of expression suppresses the output
- To split a statement a cross multiple lines, enter three periods … at the end of the line to indicate that it continues on the next line. E.g.,

```
(6 +9)…
/(4 - 6)
```

Assignment 1

1. Write one page notes on number representation and display in Matlab using examples.
2. Use Matlab to compute the sin of ∏/3 expressed as a rational number.