

# Engineering Analysis – Fall 2009

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# Lecture 3

- Last time
  - Analytical and Numerical Methods for Model Solving
- Today:
  - Overview of Matlab
  - Laplace Transform
  - Solving differential equations using the Laplace Transform
  - Example
- Next Time
  - Arrays in Matlab
  - Graphics
  - Number representation and roundoff errors

# Matlab

- The workspace → The environment (address space) where all variables reside.
- After carrying out a calculation, MATLAB assigns the result to the built-in variable called *ans*;
- A “%” character marks the beginning of a comment line.
- Three windows:
  - Command window – used to enter commands and data
  - *Edit window*\_- used to create and edit M-files (programs) such as the factor. For example, we can use the editor to create *factor.m*
  - *Graphics window(s)*\_- used to display plots and graphics

# Command window

- Used to enter commands and data. The prompt is “>>” ;

Allows the use of Matlab as a calculator when commands are typed in line by line, e.g.,

```
>> a = 77 - 1
```

```
ans = 61
```

```
>> b = a * 10
```

```
ans = 610
```

# System commands:

- *who/whos* → list all variables in the workspace
- *clear* → removes all variables from the workspace
- *computer* → lists the system MATLAB is running on
- *version* → lists the toolboxes (utilities) available

# Script file - set of MATLAB commands

- Example: the script *factor.m*:

```
function fact = factor(n)
x=1;
for i=1:n
x=x*i;
end
fact=x;
fprintf('Factor %6.3f %6.3f \n' n, fact);
end
```

- Scripts can be executed by:
  - (i) typing their name (without the .m) in the command window;
  - (ii) selecting the Debug, Run (or Save and Run) command in the editing window; or
  - (iii) hitting the F5 key while in the editing window.
- Option (i) will run the file as it exists on the drive, options (ii) and (iii) save any edits to the file. Example:

```
>> factor(12)
ans =
479001600
```

# Variable names

- *Variable names* → up to 31 alphanumeric characters (letters, numbers) and the underscore (`_`) symbol; must start with a letter.
- Reserved names for variables and constants.
  - ans - Most recent answer.
  - eps - Floating point relative accuracy.
  - realmax - Largest positive floating point number.
  - realmin - Smallest positive floating point number.
  - pi - 3.1415926535897....
  - i - Imaginary unit.
  - j - Imaginary unit.
  - inf - Infinity.
  - nan - Not-a-Number.
  - isnan - True for Not-a-Number.
  - isinf - True for infinite elements.
  - isfinite - True for finite elements.
  - why - Succinct answer.

# Variable names (cont'd)

- To report the value of variable *kiki* type its name:

```
>> kiki  
    kiki =  
        13
```

- To prevent the system from reporting the value of variable *kiki* append the semi-solon (;) at the end of a line:

```
>> kiki = 13;
```

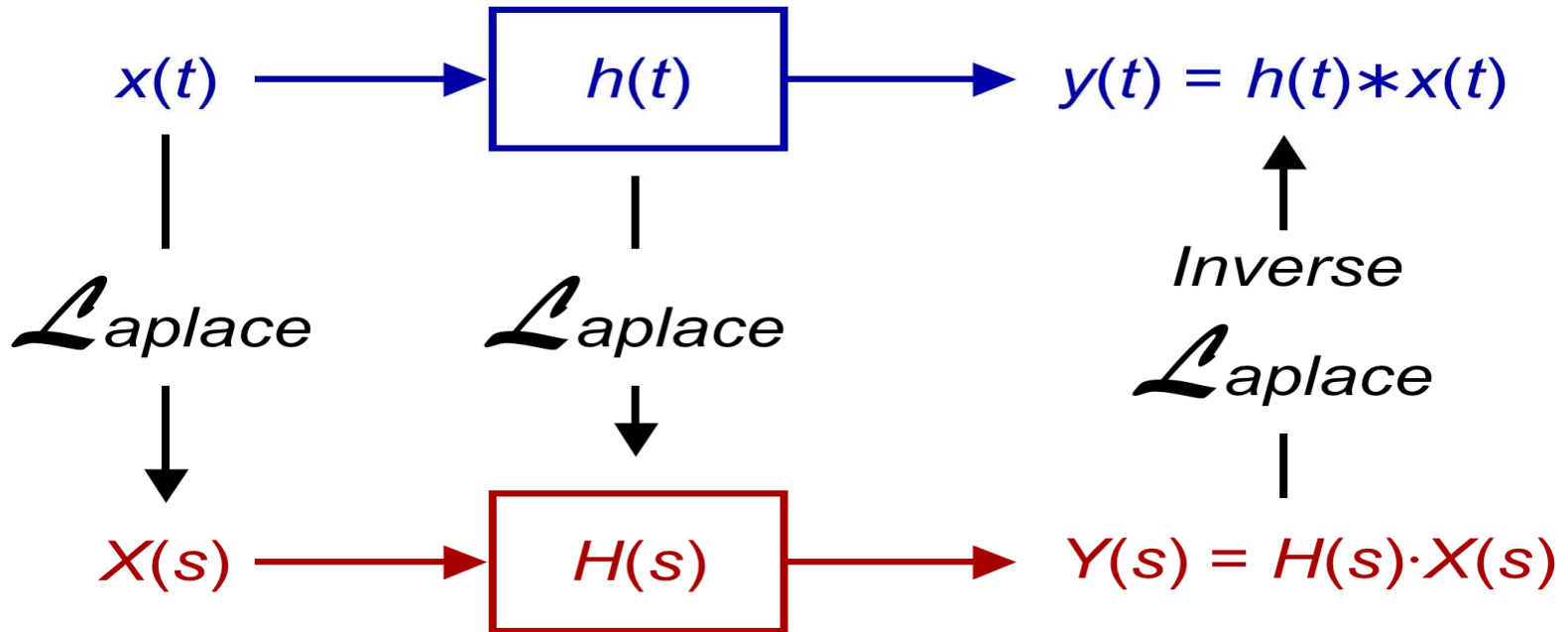
# Transform Methods

- Basic idea: find a convenient representation of the equations describing a physical phenomena.
- For example, in signal analysis rather than analyzing a function of time,  $s(t)$ , study the spectrum of the signal  $S(f)$ , in other words carry out the analysis in the frequency domain rather than the time domain.
- Advantage of Fourier (spectral analysis):
  - More intuitive physical representation
  - Instead of correlation (an intensive numerically problem) use multiplication.

# Properties of the Laplace Transform

- Linearity
- Scaling
- Frequency shifting
- Time shifting
- Frequency differentiation
- Frequency integration
- Differentiation
- Integration
- Convolution

## Time domain



## Frequency domain