

# **BLM2041 Signals and Systems**

## **Syllabus**

### **The Instructors:**

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# Course Details

- Course Code : BLM 2041
- Course Name:  
Signals and Systems for Computer Engineers  
(Bilgisayar Mühendisleri için Sinyaller ve Sistemler)

Instructor :

1- Dr. Öğr. Üyesi Ali Can Karaca

2- Öğr. Gör. Dr. Ahmet Elbir

# Assessment

Method	Quantity	(%)
Quiz	-	00
Homework	3-4	25
Midterm Exam(s)	1	35
Final Exam	1	40
Attendance & participation	-	00

By University Rule:

Your average < 40 → FF

# Course Outline

## 1. Introduction.

Mathematical Representation of Signals. Mathematical Representation of Systems.

## 2. Sinusoids.

Review of Sine and Cosine Functions. Sinusoidal Signals. Sampling and Plotting Sinusoids. Complex Exponentials and Phasors. Phasor Addition. Time Signals.

## 3. Spectrum Representation.

The Spectrum of a Sum of Sinusoids. Beat Notes. Periodic Waveforms. Fourier Series Analysis and Synthesis. Time-Frequency Spectrum. Frequency Modulation.

## 4. Sampling and Aliasing.

Sampling. Spectrum View of Sampling and Reconstruction. Discrete-to-Continuous Conversion. The Sampling Theorem.

## 5. Continuous-Time LTI Systems and the Convolution Integral.

Establishing a General Input-Output Relationship. Working with the Convolution Integral.

## 6. Discrete-Time LTI Systems and the Convolution Sum.

Specializing the Input/Output Relationship. Working with the convolution Sum.

## 7. LTI System Differential and Difference Equations in the Time Domain.

Obtaining the differential/difference equations for the input-output relations of systems. Solution of differential and discrete euations in the time domain.

# Course Outline

## 8. The Fourier Transform for Continuous-Time Signals and Systems.

Continuous-Time Aperiodic Signals. Continuous-Time Fourier Transform. Properties of Continuous-Time Fourier Transform.

## 9. The Discrete Time Fourier Transform for Discrete-Time Signals.

Discrete-Time Aperiodic Signals. Discrete-Time Fourier Transform. Properties of Discrete-Time Fourier Transform

## 10. The Laplace Transform for Continuous Time.

Laplace Transform. Common Laplace Transforms. Properties Of the Laplace Transform. Inverse Laplace Transform. Poles and Zeros in the s-plane.

## 11. The Z Transform for Discrete Time.

Z Transform. Common Z Transforms. Properties Of the Z Transform. Inverse Z Transform. Poles and Zeros in the z-plane.

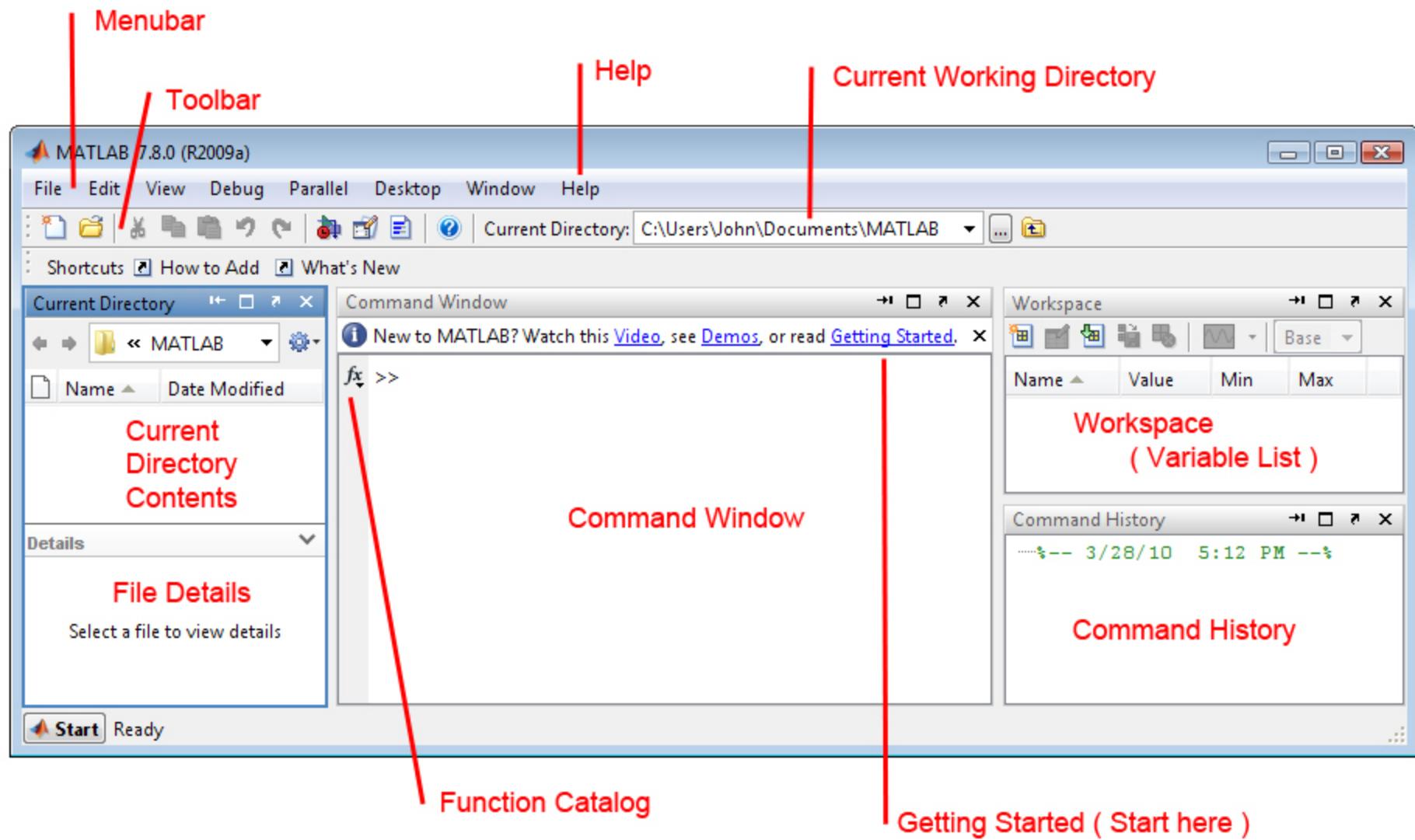
# COURSE OBJECTIVES

- Students will be able to:
- Understand **mathematical** descriptions of Signals and Systems
- Express those descriptions as computer **implementations** (**MATLAB, OCTAVE, SCILAB, R, PYTHON**)
  - Yıldız Technical University provides MATLAB License.
  - OCTAVE, SCILAB, R and PYTHON are free

# COURSE OBJECTIVES

- MATLAB
  - <https://www.mathworks.com/>
- SCILAB
  - <https://www.scilab.org/>
- OCTAVE
  - <https://www.gnu.org/software/octave/>
- R
  - <https://www.r-project.org/>
- PYTHON
  - <https://www.python.org/>

# MATLAB environment



# SCILAB environmet

The screenshot shows the Scilab graphical user interface. The main window is titled "Console Scilab".

**Console Scilab:**

```
Initialisation :
Chargement de l'environnement de travail

-->a=rand(10,10)
a =
```

column 1 to 5

0.2113249	0.5608486	0.3076091	0.5015342	0.2806498
0.7560439	0.6623569	0.9329616	0.4368588	0.1280058
0.0002211	0.7263507	0.2146008	0.2693125	0.7783129
0.1303271	0.1985144	0.3122642	0.4325745	0.2119030
0.6653811	0.5442573	0.3616361	0.4051954	0.1121355
0.6283918	0.2320748	0.2922267	0.9184708	0.6856896
0.8497452	0.2312237	0.5664249	0.0437334	0.1531217
0.6857310	0.2164633	0.4826472	0.4818509	0.6970851
0.8782145	0.8833888	0.3321719	0.1639556	0.8415518
0.0683740	0.6525135	0.5935095	0.4148104	0.4062025

column 6 to 10

0.4094825	0.3873779	0.5376230	0.5878720	0.6488563
0.8784126	0.9222899	0.1199926	0.4829179	0.9923191
0.1138340	0.9488184	0.2256303	0.2232865	0.0500420
0.1998338	0.3435337	0.6274093	0.8400886	0.7485507
0.5618661	0.3760119	0.7608433	0.1205996	0.4104059
0.5896177	0.7340941	0.0485566	0.2855364	0.6084526
0.6853980	0.2615761	0.6723950	0.8607515	0.8544211
0.8906225	0.4993494	0.2017173	0.8494102	0.0642647
0.5042213	0.2638578	0.3911574	0.1257061	0.8279083
0.3493615	0.5253563	0.8300317	0.9931210	0.9262344

-->

**Navigateur de fichiers:**

Initialisation : Chargement de l'environnement de travail

Console Scilab

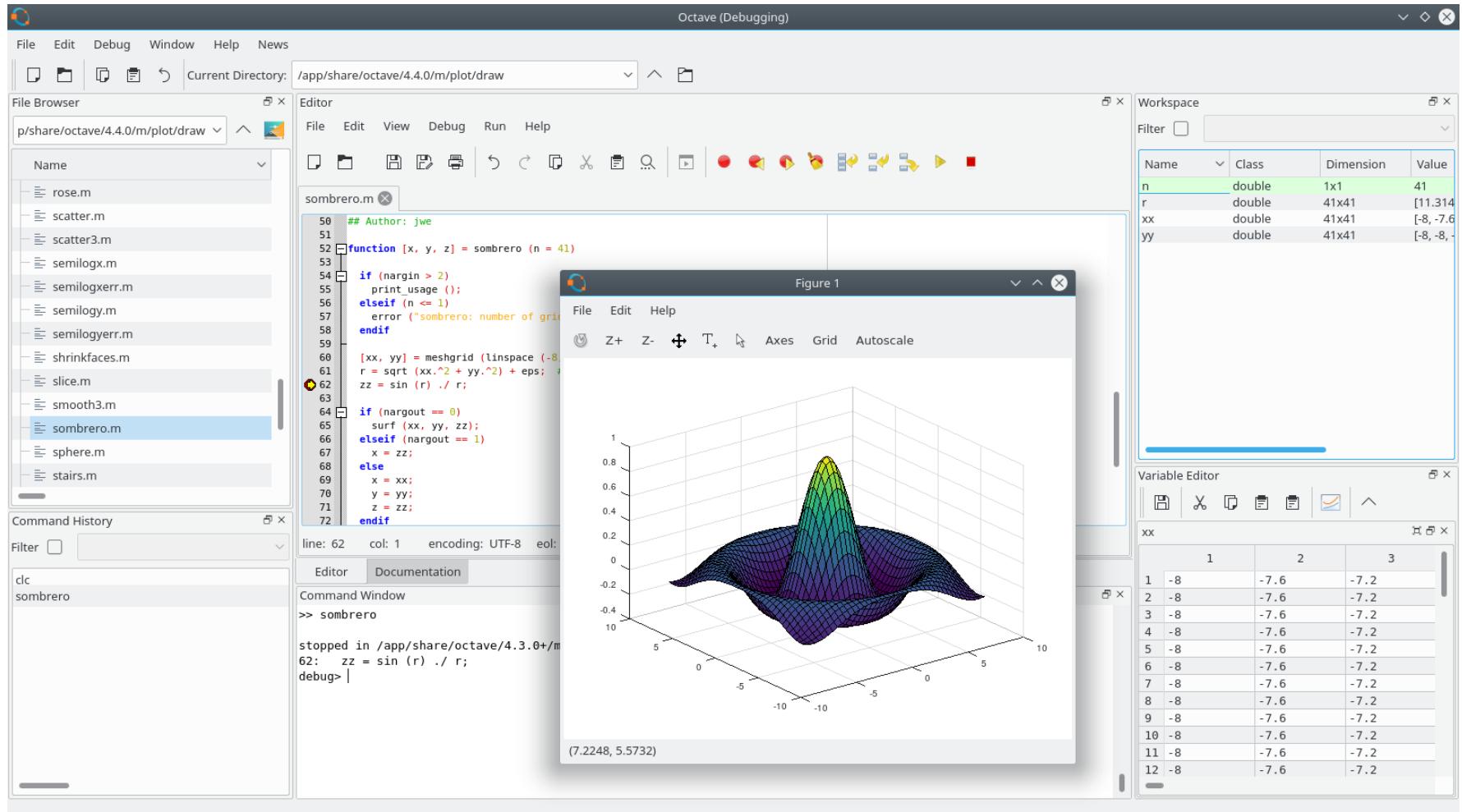
Navigateur de variables

Nom	Dimension	Type	Visibilité
a	10x10	Double local	
home	1x1	Chaine de... local	
PWD	1x1	Chaine de... local	
%ok	1x1	Booléen local	
%nf	1x1	Booléen local	
%rt	1x1	Booléen local	
%nan	1x1	Double local	
%ninf	1x1	Double local	
SCI	1x1	Chaine de... local	
SCIHOME	1x1	Chaine de... local	
TMPDIR	1x1	Chaine de... local	
%igul	1x1	Booléen local	
%itfhw	1x1	Booléen local	
%xt	1x1	Booléen local	
%xf	1x1	Booléen local	
%eps	1x1	Double local	
%lo	1x2	Double local	
%li	1x1	Double local	
%se	1x1	Double local	
%pi	1x1	Double local	
%toolboxWa...	1x1	Booléen global	
%toolbox...	1x1	Double global	
%toolbox...	1x1	Chaine de... global	

Historique des commandes

```
> // -- 29/08/2012 09:25:18 -- //
> // -- 29/08/2012 11:36:14 -- //
    a=rand(10,10)
```

# OCTAVE environment



# Rstudio (IDE for R)

RStudio

File Edit View Workspace Plots Help

diamondPricing.R\* diamonds

Source on Save Run Line(s) Run All

```
library(ggplot2)
View(diamonds)
summary(diamonds)

summary(diamonds$price)
aveSize <- round(mean(diamonds$carat),4)
clarity <- levels(diamonds$clarity)

qplot(price, carat, data = diamonds)
qplot(price, carat, data = diamonds, color=clarity,
  xlab = "Price", ylab = "Carat",
  main = "Diamond Pricing") +
  opts(plot.title = theme_text(size = 22))
```

Workspace History

Load Save Import Dataset Clear All

Data diamonds 53940 obs. of 10 variables  
Values aveSize 0.7979  
clarity character [8]

Files Plots Packages Help

Zoom Export Print Clear All

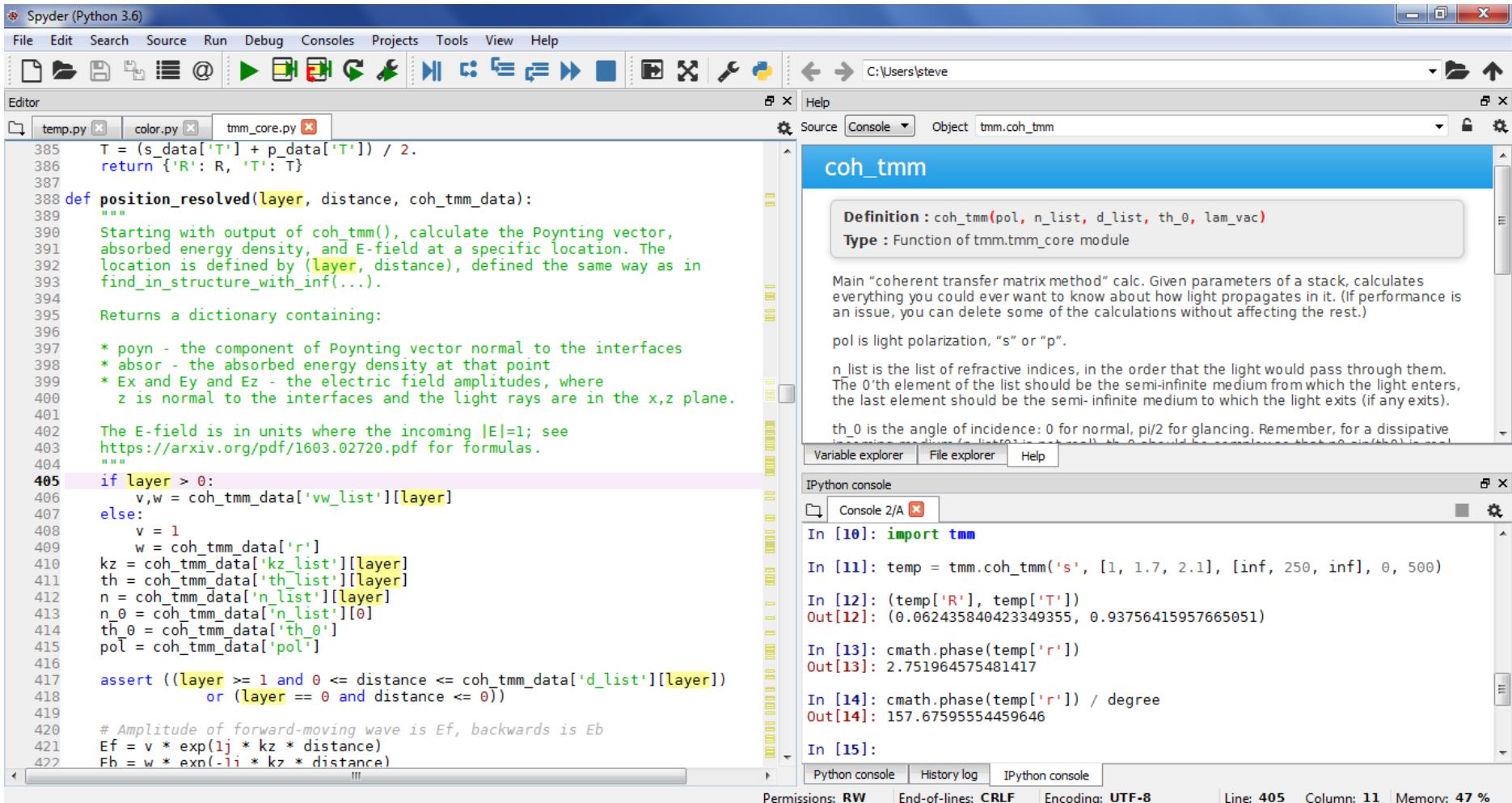
Diamond Pricing

Console ~/

```
1st Qu. : 4.710 1st Qu. : 4.720 1st Qu. : 2.910
Median : 5.700 Median : 5.710 Median : 3.530
Mean : 5.731 Mean : 5.735 Mean : 3.539
3rd Qu. : 6.540 3rd Qu. : 6.540 3rd Qu. : 4.040
Max. : 10.740 Max. : 58.900 Max. : 31.800

> summary(diamonds$price)
  Min. 1st Qu. Median Mean 3rd Qu. Max.
  326    950   2401  3933  5324 18820
> aveSize <- round(mean(diamonds$carat),4)
> clarity <- levels(diamonds$clarity)
> qplot(price, carat, data = diamonds)
> qplot(price, carat, data = diamonds, color=clarity, xlab =
"Price", ylab = "Carat", main = "Diamond Pricing") +
  opts(plot.title = theme_text(size = 22))
> |
```

# Spyder (IDE for PHTHON)



# Course Objectives (In details)

## Academic knowledge

- Students will be able to:
  - Understand and develop simple mathematical models for representing signals and systems
  - Understand the relationship between time and frequency domain models of dynamic systems
  - Convert time to frequency-domain models and vice versa
  - Understand the relationship between continuous and discrete-time models

## Intellectual skills

- Students will be able to:
  - Build a mathematical model from a real-life problem related to signals and systems
  - Interpret results achieved by mathematical solutions

## Practical skills

- Students will be able to:
  - Express models and methods as computer implementations (MATLAB or OCTAVE)
    - Yildiz Technical University provides MATLAB License.
  - Apply Matlab/Octave for analysis and simulation of continuous and discrete time systems
  - Analyse mathematical solutions in the context of the original problem

## Transferable skills

- Students will be able to:
  - Choose appropriate approach in problem solving situation
  - Present and communicate formalised results and conclusions

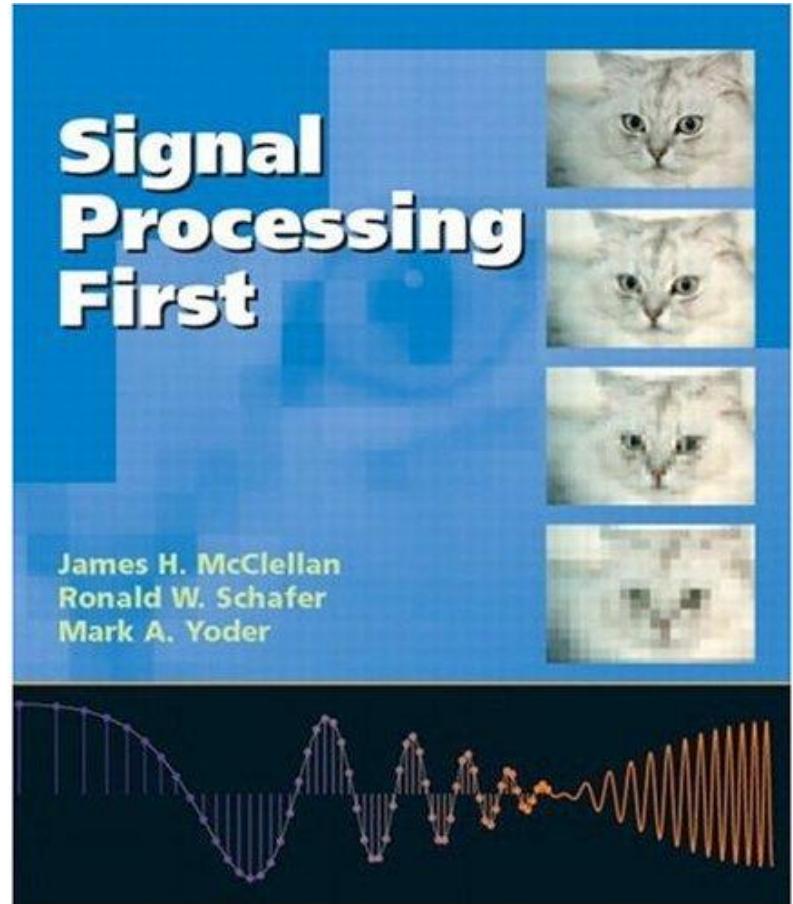
# Main course book

**Signal Processing First**

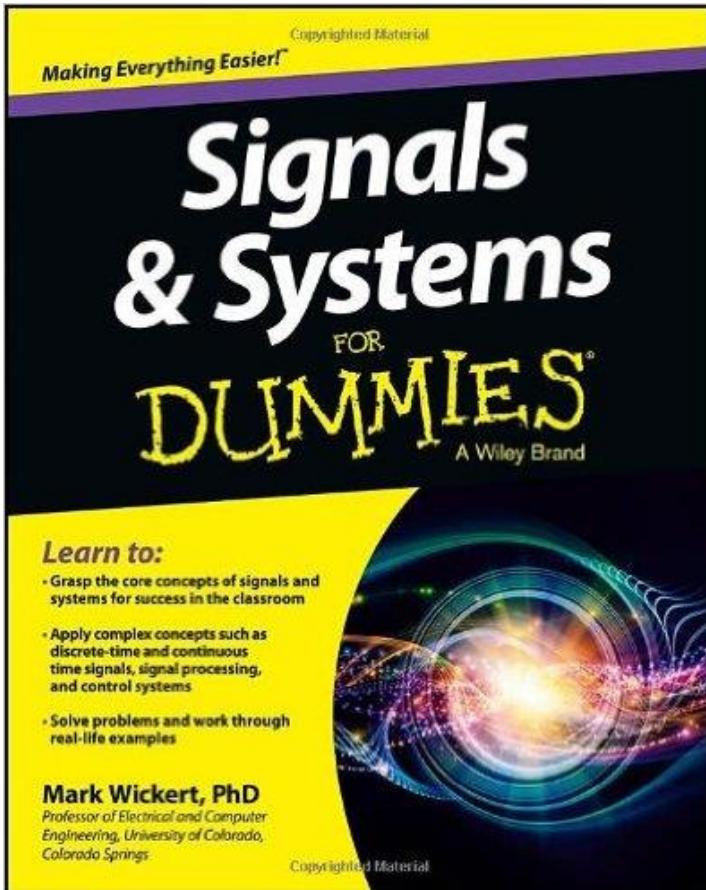
by James H McClellan,  
Ronald W. Schaffer  
and Mark A. Yoder.

Published by Prentice  
Hall.

Isbn: 0-13-120265-0



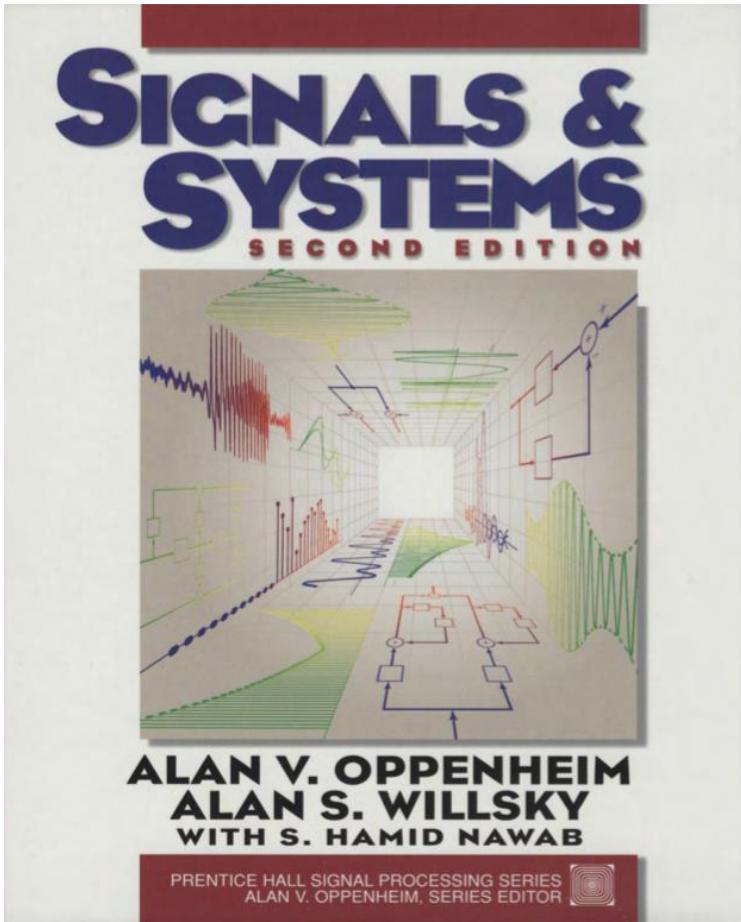
# Some Other Books



- by [Mark Wickert](#)

Wickert, Mark. *Signals and Systems for Dummies*. John Wiley & Sons, 2013.

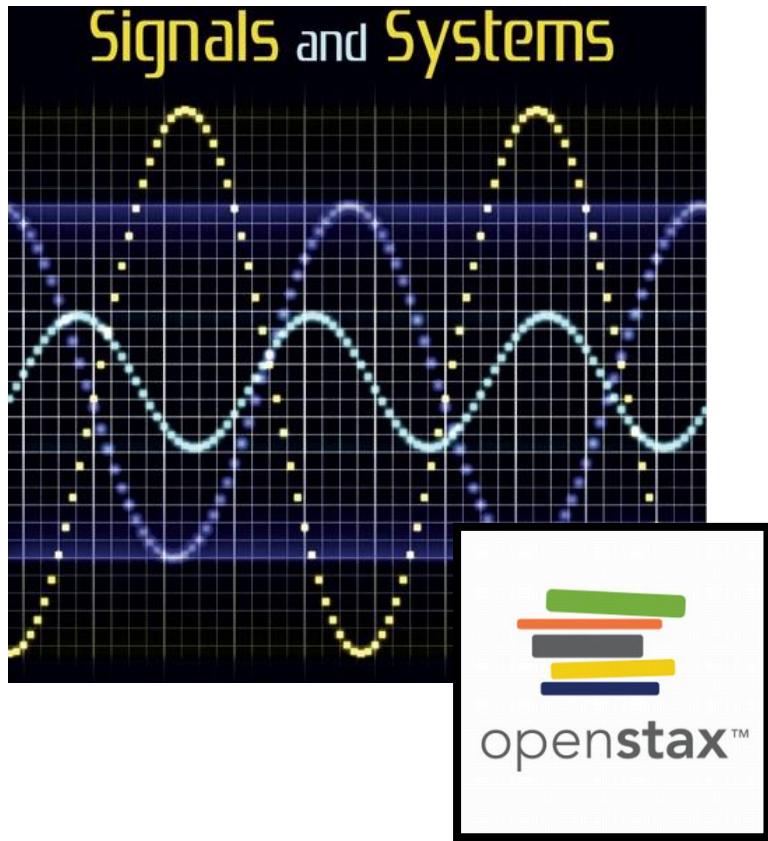
# Some Other Books



- by Alan. V. Oppenheim and Alan S. Willsky

Oppenheim, Alan V., Alan S. Willsky, and Syed Hamid Nawab. "Signals and systems 2nd ed." *New Jersey: Prentice Hall*(1997).

# Some Other Books



- Online e-book by [Richard Baraniuk](#)

<https://cnx.org/contents/d2CEAGW5>

# Rules of the Conduct

- No eating /drinking in class
  - *except water*
- Cell phones must be kept outside of class or switched-off during class
  - *If your cell-phone rings during class or you use it in any way, you will be asked to leave and counted as unexcused absent.*
- No web surfing and/or unrelated use of computers,
  - when computers are used in class or lab.

# Rules of the Conduct

- You are responsible for checking the class web page often for announcements.
- Academic dishonesty and cheating will not be tolerated and will be dealt with according to university rules and regulations
  - *Presenting any work, or a portion thereof, that does not belong to you is considered academic dishonesty.*
- University rules and regulations:
  - <http://www.ogi.yildiz.edu.tr/category.php?id=17>
  - [https://www.yok.gov.tr/content/view/544/230/lang,tr\\_TR/](https://www.yok.gov.tr/content/view/544/230/lang,tr_TR/)

# Attendance Policy

- The requirement for attendance is **70%**.
  - *Hospital reports are not accepted to fulfill the requirement for attendance.*
  - *The students, who fail to fulfill the attendance requirement, will be excluded from the final exams and the grade of F0 will be given.*
  - Absent more than 12 hours → F0

# Seeing the Big Picture

Getting Started  
with Signals and  
Systems

Exploring the  
Time Domain

Picking Up the  
Frequency  
Domain

Entering the  $s$ -  
and  $z$ -Domains

