Signal Processing and Linear Systems1

Lecture 1: Course Overview

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This class is an exploration.

Together we are taking a journey through a new and wondrous land.

“A teacher is never a giver a truth; he is a guide, a pointer to the truth that each student must find for himself.”
- Bruce Lee

Theory and Practice

In this class, we will focus on developing our practice by understanding the theory well and then applying that theory.

Our proofs will be “engineering proofs”. We will use proofs to support our understanding. We will not prove everything.

Grade Breakdown

Assignments - (30% of your grade)

Midterm (30% of your grade)

Final (40% of your grade)

Assignments

Due dates are strict and specified in the assignment.

If assignments are submitted within 24 hours late, you will receive half credit

Past a day, you will receive no credit.

Your homework must be immaculate.

You might wonder why?

- Communication is of paramount importance. In this class, you will start learning to communicate your ideas clearly, effectively, and concisely.
- Having clear work actually helps solve the problem better. Clarifying your work forces you to clarify the ideas in your mind.
- You don't want your messiness to get in the way of your audience appreciating your ideas.

All good things!!!

If you cannot write legibly, type your homework.

Good

Assignment 3

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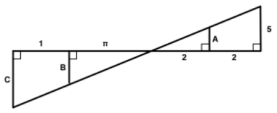
1 Main Problems

Problem 1 Find the lengths of lines A, B, and C in the image below.



Problem 2 Write a function that accepts three (x, y) points and returns the area of a triangle. The prototype of the function should be as follows:

```
function area = areaOfTriangle( x1, y1, x2, y2, x3, y3 )
```

Problem 3 Write a function that accepts a natural number and outputs a triangle of numbers so that the elements in each column indicate the reverse column id. The prototype of the function should be as follows:

```
function makeNumberTriangle( N )
```

A sample output where the input number $N = 4$ is shown below

```
     1
   2 1
 3 2 1
4 3 2 1
```

Problem 4 Find the length of line AC. (Hint, this should take you almost no time at all). *Source: My Best Mathematical and Logic Puzzles by Martin Gardner.*

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Acceptable

Written in pen

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1) Show $\alpha\alpha^* + \beta\beta^* = 1$.

Proof:

$\alpha = \cos\theta/2 - i n_\theta \sin\theta/2, \quad \beta = -i(n_x + i n_y)\sin\theta/2.$

$\alpha\alpha^* = (\cos\theta/2 - i n_\theta \sin\theta/2)(\cos\theta/2 + i n_\theta \sin\theta/2)$
$= \cos^2\theta/2 + n_\theta^2 \sin^2\theta/2.$

$\beta = -i n_x \sin\theta/2 + n_y \sin\theta/2$

$\Rightarrow \beta\beta^* = (n_y \sin\theta/2 - i n_x \sin\theta/2)(n_y \sin\theta/2 + i n_x \sin\theta/2)$
$= n_y^2 \sin^2\theta/2 + n_x^2 \sin^2\theta/2 = (n_x^2 + n_y^2)\sin^2\theta/2.$

$\Rightarrow \alpha\alpha^* + \beta\beta^* = \cos^2\theta/2 + n_\theta^2 \sin^2\theta/2 + (n_x^2 + n_y^2)\sin^2\theta/2$

$= (n_x^2 + n_y^2 + n_\theta^2)\sin^2\theta/2 + \cos^2\theta/2. \quad \cdots\cdots \textcircled{1}$

Lemma: $\|n\|_2 = 1$.

Proof:

$n = \gamma/|\omega|\,(B_{1x}, B_{1y}, G_z).$

$\Rightarrow \|n\|_2^2 = \gamma^2/|\omega|^2\,(B_{1x}^2 + B_{1y}^2 + G_z^2).$

$\omega = -\gamma\sqrt{B_{1x}^2 + B_{1y}^2 + G_z^2} \Rightarrow |\omega|^2 = \gamma^2(B_{1x}^2 + B_{1y}^2 + G_z^2).$

$\Rightarrow \|n\|_2^2 = 1.$

By the above lemma, from ①

$\alpha\alpha^* + \beta\beta^* = \sin^2\theta/2 + \cos^2\theta/2 = 1.$ ∎

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Unacceptable

Use your own judgement.

Are you proud of the document you're turning in? If so, then it's probably acceptable.

Turn in your assignments by email
If you've written portions by hand, scan them in

Assignments must be emailed as *a single *.pdf document*.

Any computer code must be typed.
No handwritten programs are accepted.

Email assignments to ndwork@stanford.edu.
Put "EE102A Summer 2017" into the subject line.

Resources

Course website
https://web.stanford.edu/~ndwork/teaching/1706ee102a/

Signal Analysis by Papoulis
Recommended but not required (Can only be bought used)

Introduction to Matrix Methods and Applications by Boyd and Vandenberghe.
(Free online book)
http://stanford.edu/class/ee103/mma.html

Teacher's Assistant

Moosa Zaidi

Has worked with MRSRL

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I'm Available

It's my goal to make you as comfortable as possible here.

If you ever feel uncomfortable about anything, please feel free to come to me.

This is going to be a tough, fun, thrilling, engaging experience.
If anything gets in the way of that, let's resolve that quickly so that we can get back to getting stuff done.

Feedback

Your feedback is very welcome at any time
Email me: ndwork@stanford.edu
Speak to a TA (make sure that they realize you're providing feedback and not just chatting).

Please provide feedback whenever you'd like.

Problem Statements

What experiments should we do to best understand our system?

How can we take noise out of a signal?

How can we undo a blur in our data?

How do radios work?

How does compression work?