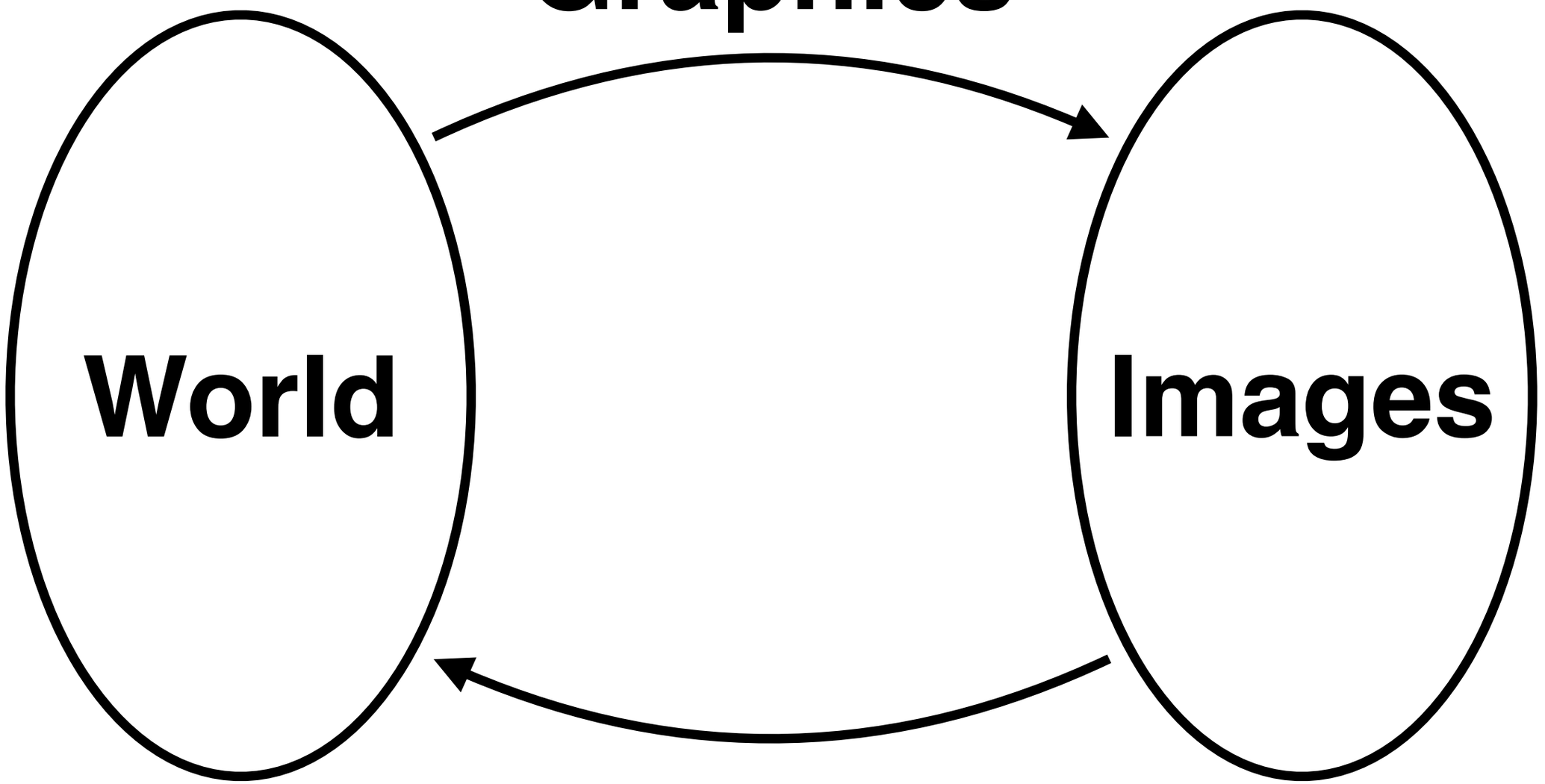
Introduction to Computer Graphics and Computer Vision

Course Syllabus

Nicholas Dwork

Computer Graphics



Computer Vision

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

You will be your own guide. I will encourage you to experiment and explore.

I will be more like a person experienced in the area rather than a tour guide.

- **I will make sure you have the right tools.**
- **I will suggest some directions you might wander.**
- ***You* will decide where you go.**

Teamwork

We are a team!

Our success or failure will depend on the cumulative achievements of all members of our team.

We are competing against no one but ourselves. It's up to us to see what we can accomplish together.

The Team

Each other! Your best resource will be each other.
I will not be able to teach you all you need to know.
You'll have to rely on yourselves and on each other.

The Internet. Do your due diligence before seeking help. Before you ask somebody for help, ask Google.

Your TAs. We're very lucky to have very capable TAs who are enthusiastic to work with you. Use them!

Me. I'll help in any way I can.

How Am I Doing?

This is a very valid question. If you're wondering, feel free to ask me.

There will probably be two formal evaluations:

- **One after the first week**
- **One at the end of the program (final evaluation)**

Morning Sessions

Each session will be divided into three subsessions.

- **Math - Programming - Physics**
- **Math - Physics - Image Processing**

We'll have breaks in between sessions:

- **Stretching**
- **Meditations**
- **Short videos**
- **Discussions**

Expectations

I expect that you will demand a continuous enthusiastic participation from yourself.

We will play a game together.

Every time you see a non-lame mistake I make, you win!

Opportunities to Learn

Assignments

- **Due on Monday and Thursday at the beginning of class.**

Main Applications

- **Several significant applications will be offered for you. Take at least one and *make it happen!***

Final Presentation

- **We will have a presentation during the final week.**
- **Each member will present a main application.**

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

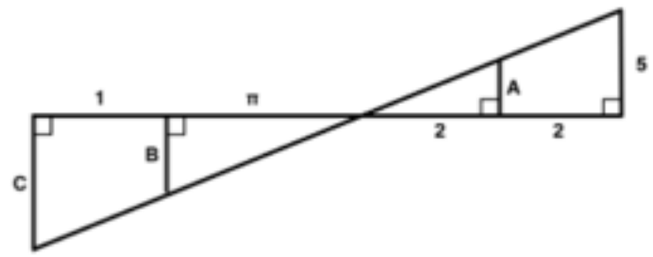
Assignment 3

Nicholas Dwork

May 10, 2015

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

$$\begin{array}{cccc} & & & 1 \\ & & 2 & 1 \\ & 3 & 2 & 1 \\ 4 & 3 & 2 & 1 \end{array}$$

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.*

Acceptable

Written in pen

Nicholas Dwork EE469B

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

Proof:

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

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

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

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

$\Rightarrow \alpha\alpha^* + \beta\beta^* = \cos^2\theta/2 + n_z^2 \sin^2\theta/2 + (n_x^2 + n_y^2)\sin^2\theta/2$
$= (n_x^2 + n_y^2 + n_z^2)\sin^2\theta/2 + \cos^2\theta/2. \quad \cdots\cdots \textcircled{1}$

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

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

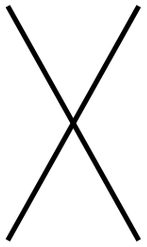
■

Unacceptable

Use your own judgement.

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

Lowercase and Uppercase



Is this a lowercase x or an uppercase X?
There's no way to know!

Don't use lower and upper case to distinguish between different entities. It confuses your reader.

Do something more.

Opportunities to Learn

All assignments must be turned in electronically.

Email assignments to ndwork@stanford.edu.
Put "SI 2015" into the subject line.

Resources

Course website

http://stanford.edu/~ndwork/si2015

Introduction to Matrix Methods and Applications by Boyd and Vandenberghe.

(Free online book)

http://stanford.edu/class/ee103/mma.html

Multiple View Geometry written by Hartley and Zisserman

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.

Main Message

Give it your all

Throw yourself into it

Challenge yourself

Be passionate

Have a blast!

“The best way to do it is to do it.”
-Amelia Earhart

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.

We'll adapt the course as we go along.