An IBL Approach to Large Coordinated Courses

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Preamble

Which is most important for making sushi the fish or rice?

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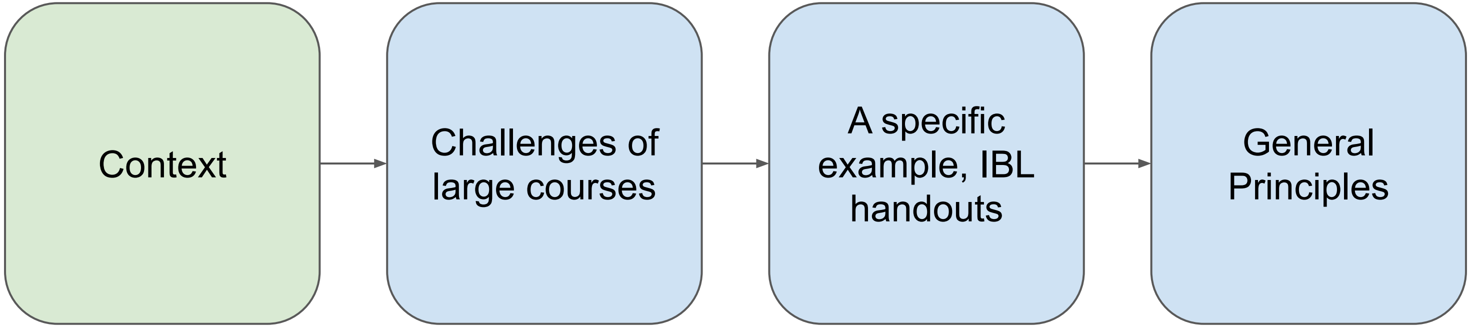
Chef Yasuda said to Anthony Bourdain *(Parts Unknown)*

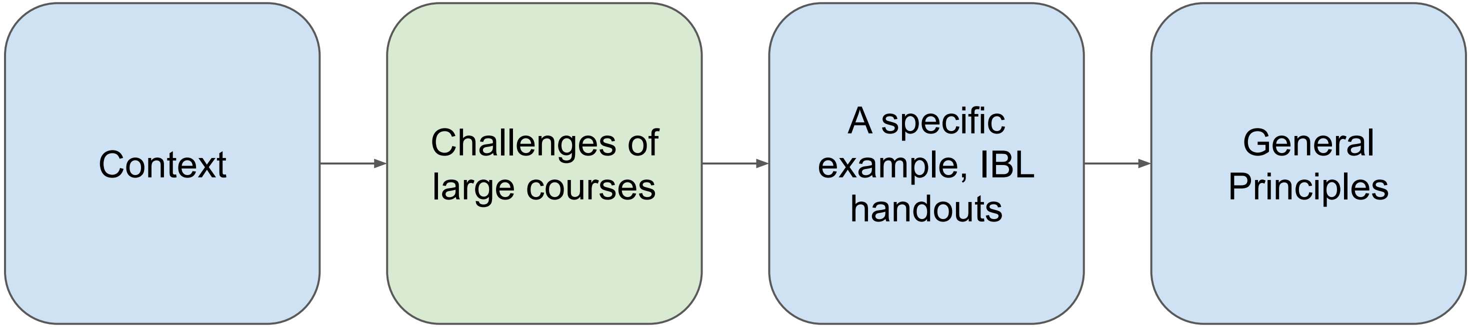
“90% rice”

Theme Implementing fundamentals well


Context
Challenges of large courses
A specific example, IBL handouts
General Principles

Context

- **TL;DR** Lots and lots of people
- Large public institution, urban, diverse, 1/3rd international students
- First-year linear algebra course
- 1500 students in fall, 1000 students in spring
- 6-8 sections of ~200 students
- 25 TAs, up to 45 recitations
- 6-8 instructors, mostly new to teaching
- 5000+ math majors and minors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Challenges

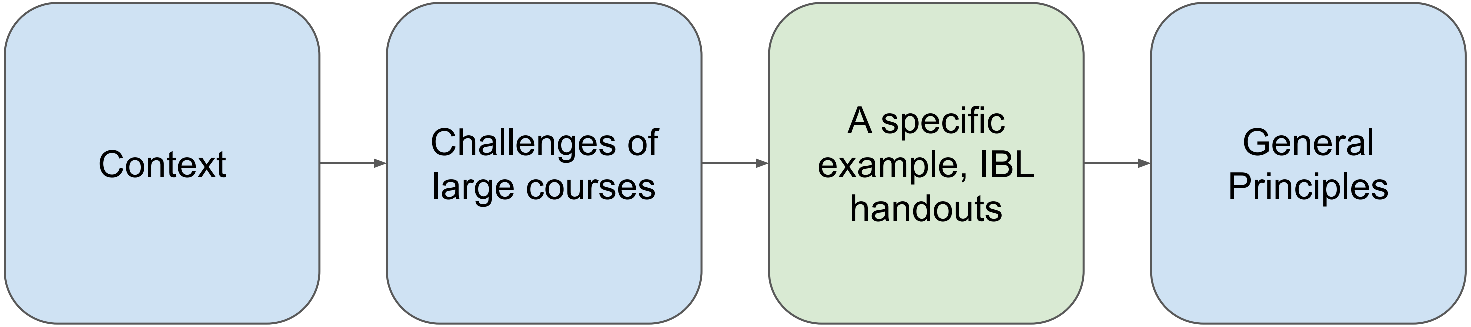
- Students are in their first-year, from diverse backgrounds
- New instructors and TAs
- High turnover
- Large class sizes

Adapting IBL/Active learning for large classes can be accomplished by creating easy-entry, high-ceiling structures

Guiding idea
Sense-making continental divide

Instructor processing ideas | Class time flowing towards student sense making

Specific Example, IBL Handouts



Key Features

- IBL handouts to “IBLize” large lectures (180-200 students)
- Significant class time on **sense making**
- Riffing off of think-pair-share
- Flexibility: instructors can modify the handouts
- Instructors can focus more time and energy on implementation, student engagement, equitable participation.

Sample Handout

Module 6 Lecture Handout

This module is about subspaces, which are sets of vectors that behave like vectors spaces. What we mean is that if you take linear combinations of vectors in a subspace, that linear combination stays in the subspace. In math we say the set is "closed" under vector addition and scalar multiplication. In this module we study the characteristics of subspaces.

1. Please review the definition of subspace.

   Subspace. A non-empty subset $V \subseteq \mathbb{R}^n$ is called a ***subspace*** if for all $\vec{u}, \vec{v} \in V$ and all scalars k we have

   (i) $\vec{u} + \vec{v} \in V$; and

   (ii) $k\vec{u} \in V$.

   Task: Let S be a subspace in $\mathbb{R}^n$. Identify the three conditions listed in the definition that define a subspace.

2. Recall that a span is a line, plane, volume, etc. containing the origin. Review the theorem below that shows subspaces and spans are the same object.

   Theorem (Subspace-Span). Every subspace is a span and every span is a subspace. More precisely, $\mathcal{V} \subseteq \mathbb{R}^n$ is a subspace if and only if $\mathcal{V} = \operatorname{span} \mathcal{X}$ for some set $\mathcal{X}$.

   Task: Find one example and one non-example of a subspace of $\mathbb{R}^3$.

3. The trivial subspace is a special case. Please read the definition and theorem.

Trivial Subspace. The subset $\{\vec{0}\} \subseteq \mathbb{R}^n$ is called the ***trivial subspace***.

Theorem. The trivial subspace is a subspace.

4. With the definitions and theorems above, find the four types of subspaces of $\mathbb{R}^3$.

5. Recall the definition of subspace.

Subspace. A non-empty subset $V \subseteq \mathbb{R}^n$ is called a ***subspace*** if for all $\vec{u}, \vec{v} \in V$ and all scalars k we have

(i) $\vec{u} + \vec{v} \in V$; and

(ii) $k\vec{u} \in V$.

Let ℓ be the set given by

$$\vec{x} = t\begin{bmatrix}1\\2\end{bmatrix} + \begin{bmatrix}0\\3\end{bmatrix}$$

Justify why ℓ is not a subspace in $\mathbb{R}^2$.

What handouts look like

Space for students to write

Teaching, Implementation

Teaching is based on riffing off of Think-Pair-Share

- Think and go
- Think, turn and talk, instructor share
- Think, partners, students share
- Longer group tasks

Range of lengths of time to implement these (short, medium, long)

Sample Think and Go (short)

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Trivial Subspace. The subset $\{\vec{0}\} \subseteq \mathbb{R}^n$ is called the ***trivial subspace***.

Theorem. The trivial subspace is a subspace.

4. With the definitions and theorems above, find the four types of subspaces of $\mathbb{R}^3$.

Instructor Actions

- “Please read #3”
- Pause 60 seconds

- #4 “Find the four types of subspaces in R^3…
- Pause 60 seconds
- Reveal and move on

Sample Think, Turn and Talk…

5. Recall the definition of subspace.

> **Subspace.** A non-empty subset $V \subseteq \mathbb{R}^n$ is called a *subspace* if for all $\vec{u}, \vec{v} \in V$ and all scalars k we have
>
> (i) $\vec{u} + \vec{v} \in V$; and
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> (ii) $k\vec{u} \in V$.

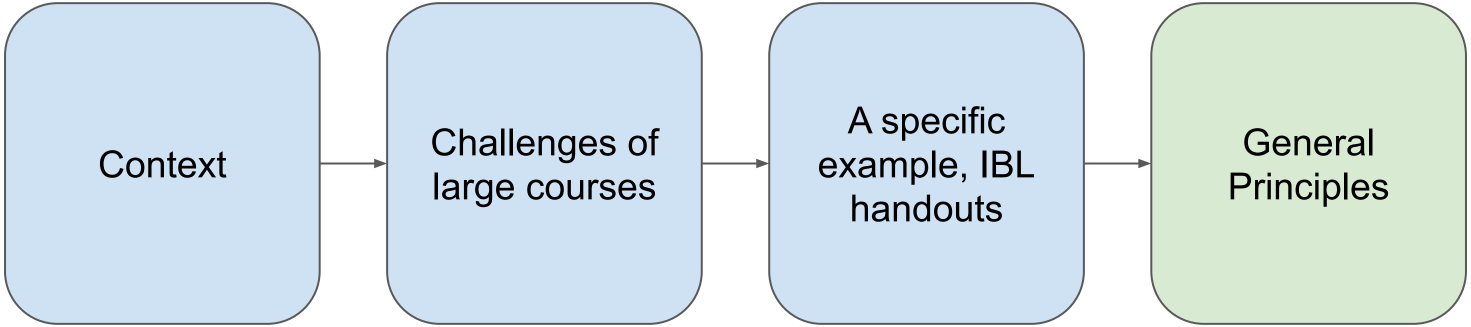
Let ℓ be the set given by

$$\vec{x} = t\begin{bmatrix}1\\2\end{bmatrix} + \begin{bmatrix}0\\3\end{bmatrix}$$

Justify why ℓ is not a subspace in $\mathbb{R}^2$.

Instructor

- Please think about why "l" is NOT a subspace. (Pause)
- Turn and talk to your partner
- Roam room, check in on students.
  - "How are you doing?"
  - "What did you try?"
  - "Have you tried graphing it?"
- Select a pair to share OR instructor share student ideas OR instructor share (depending on room
- Recap what was learned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- Emphasis on students making sense of ideas, strategies.
- Short, medium, and long versions of **think-pair-share** provide easy-entry, high ceiling teaching strategies
- Pre-made handouts that are designed for active learning that can also be modified

Communication

- Weekly instructor meetings are useful!
- Slack/teams/email
- Instructor resources

Recitations/Tutorials can be setup in a similar way. Tutorial handouts that provide a structure for TAs to implement

Not discussed

- Assessment (Grading growth)
- Logistics, LMS, discussion boards

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