Clinical Assistant or Associate Professor in Online Education Candidate

Shaping the Future of Online Education: A Game Design Perspective

Welcome! Please come on in and have a seat.
This live performance is part of the teaching demonstration.

Dr. Yaguang Zhang

May 5, 2023 | 10:30-11:30 AM EDT

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College of Agriculture

Shaping the Future of Online Education: A Game Design Perspective

Dr. Yaguang Zhang

May 5, 2023

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- Shaping the Future of Higher Education?
  Becoming a Land-grant University for Our Times

- Shaping the Future of Higher Education? Becoming a Land-grant University for Our Times
- Shaping the Future of Education as a Pioneering Institute

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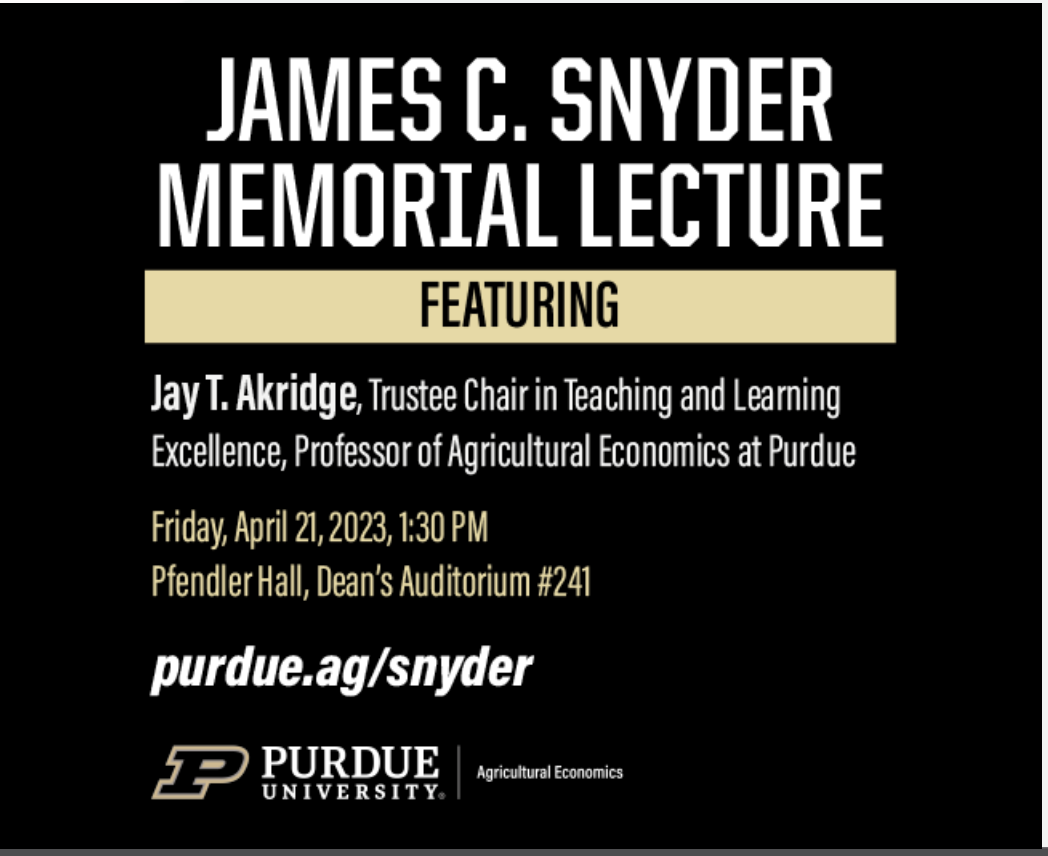

Encouraging 😀

- Title

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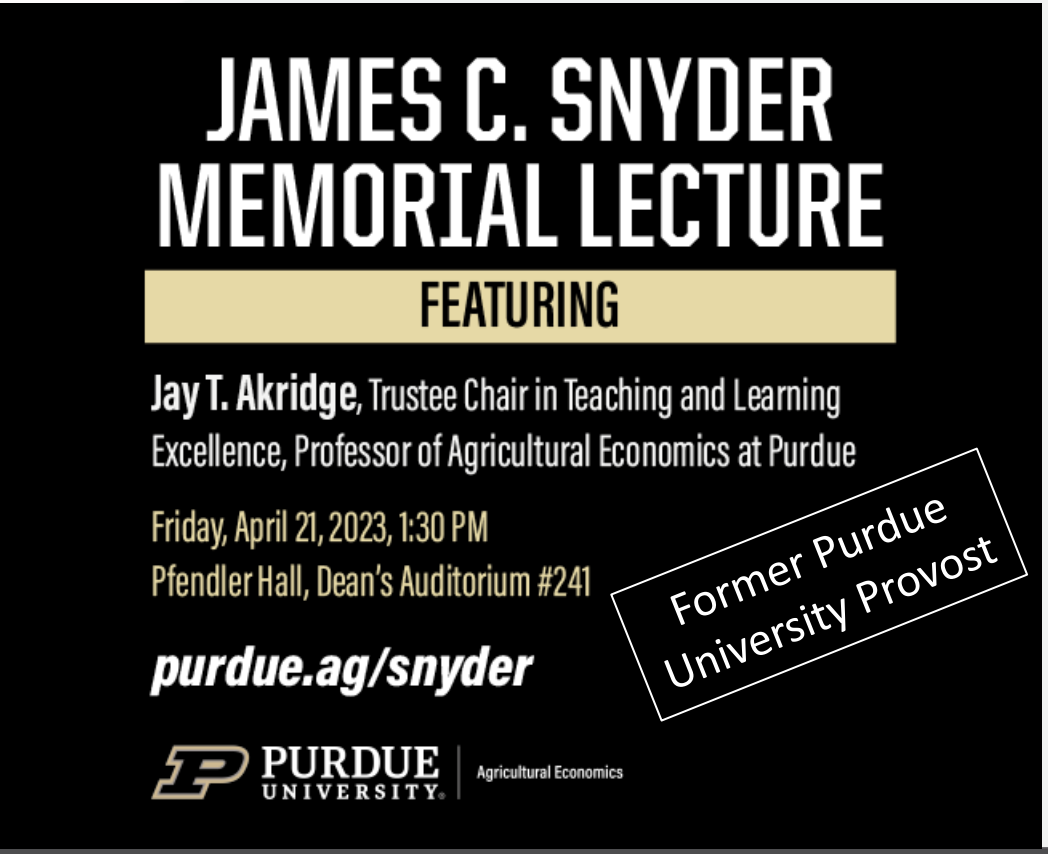

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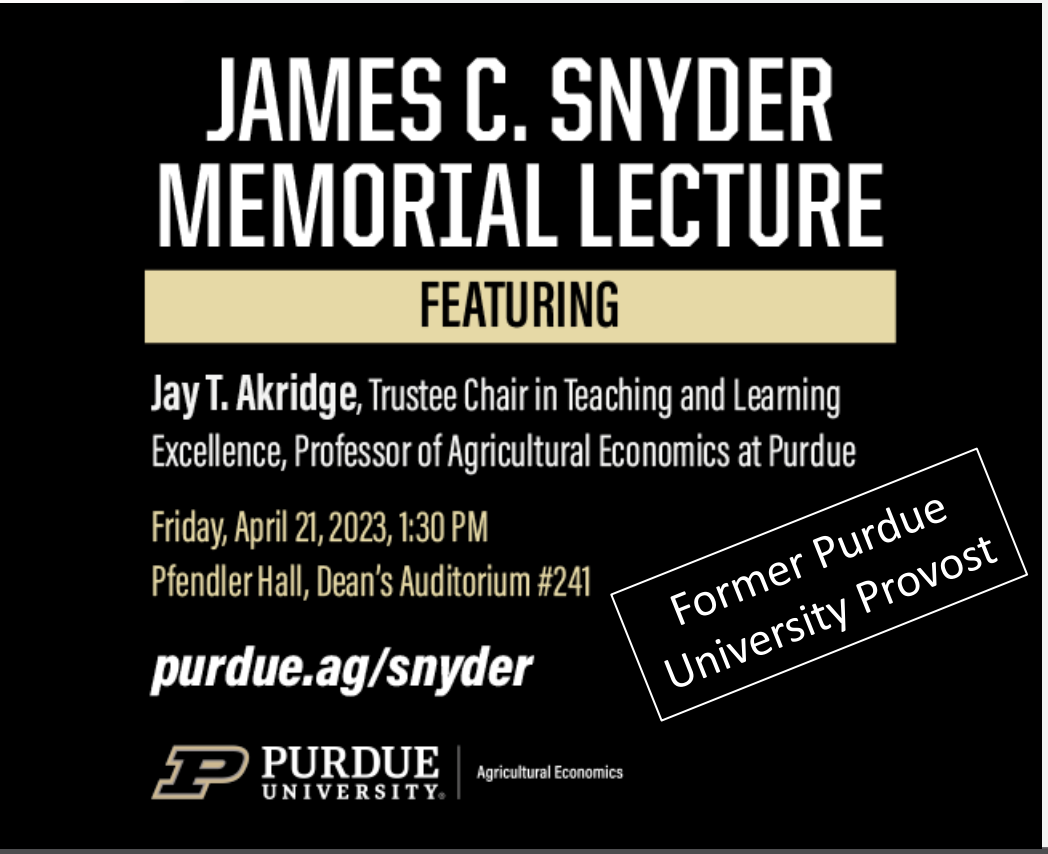

Encouraging 😀
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Discouraging 😢
- Experience

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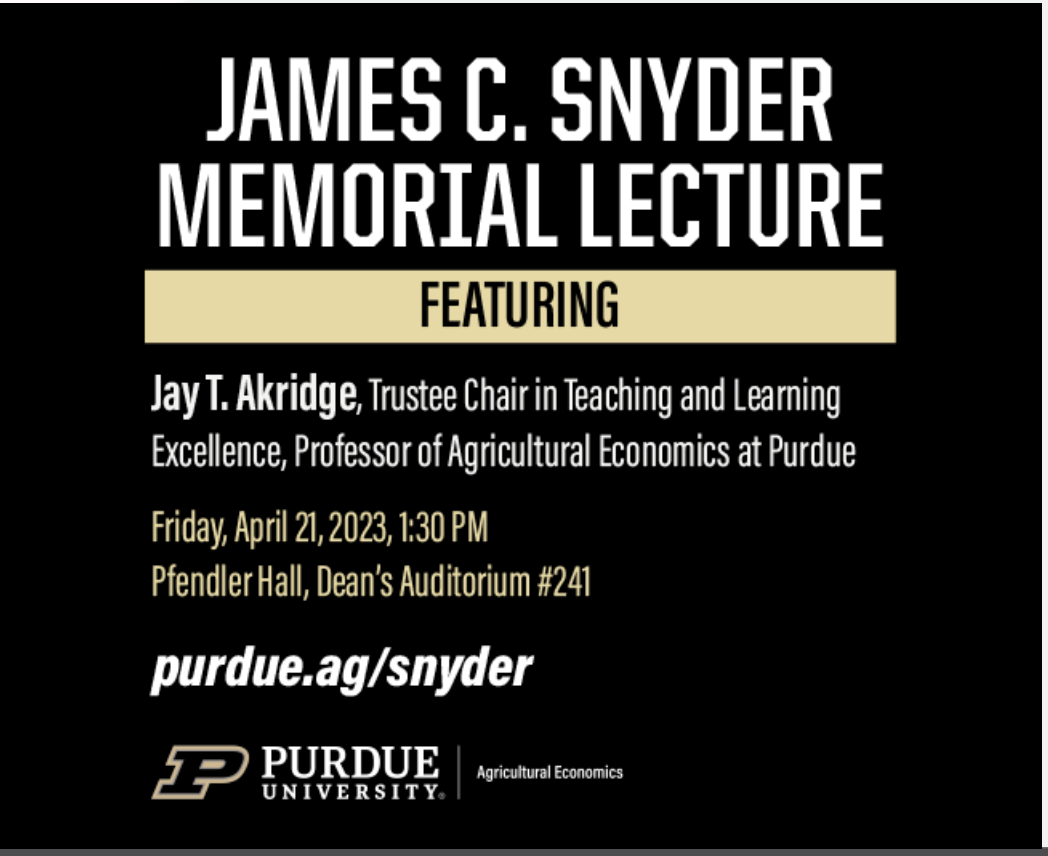

Encouraging 😃
- Title
- Challenges

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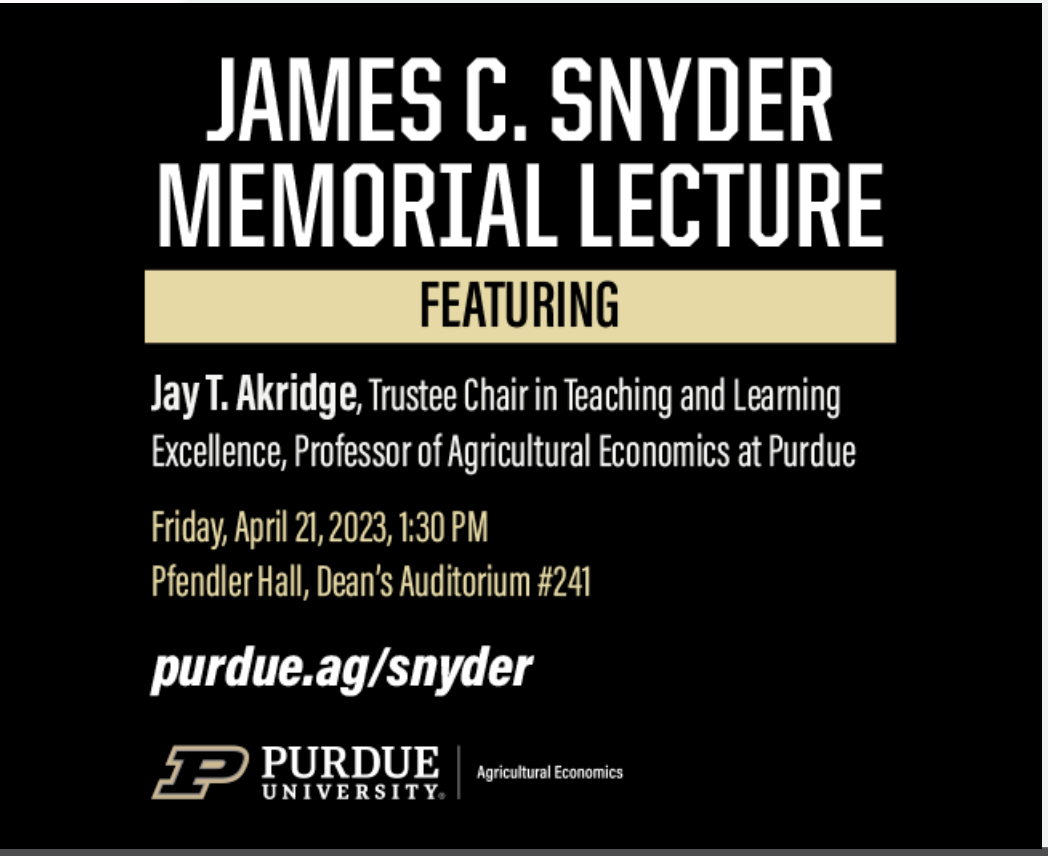

Encouraging 😀
- Title
- Challenges

Discouraging 😢
- Experience
- No solutions

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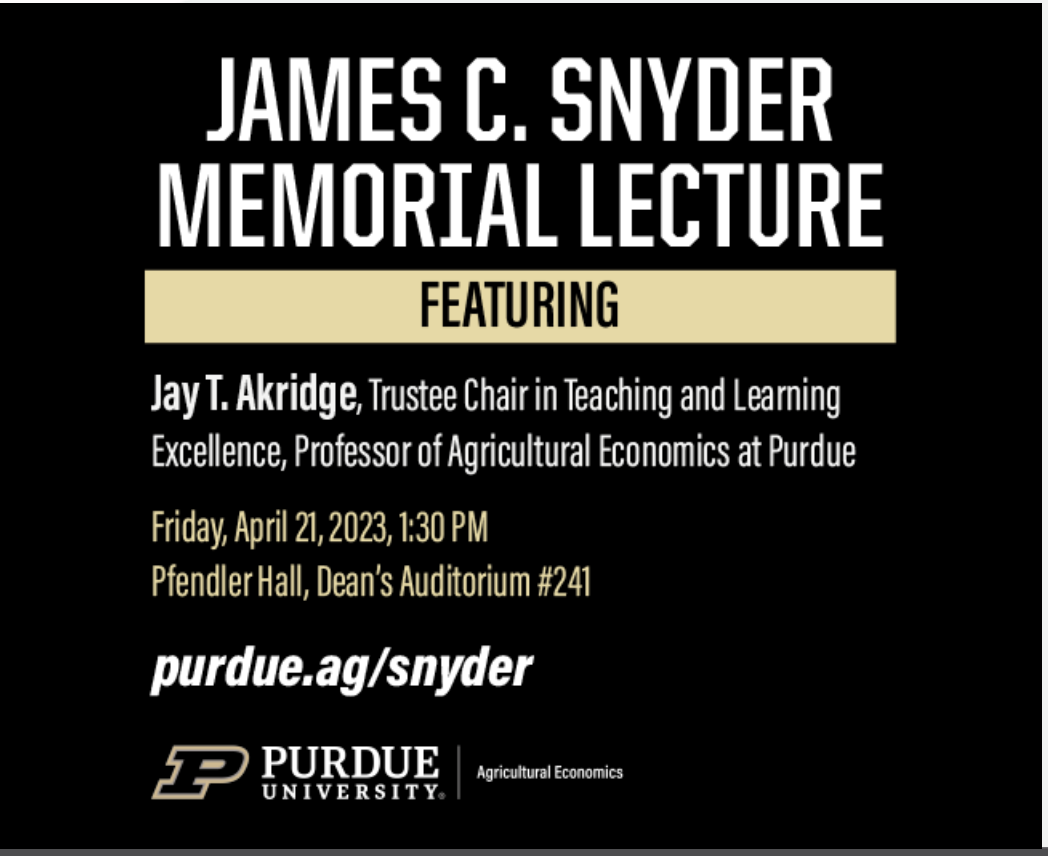

High-level

- Public opinions
- College enrollment
- Campus experience
- Community
- …

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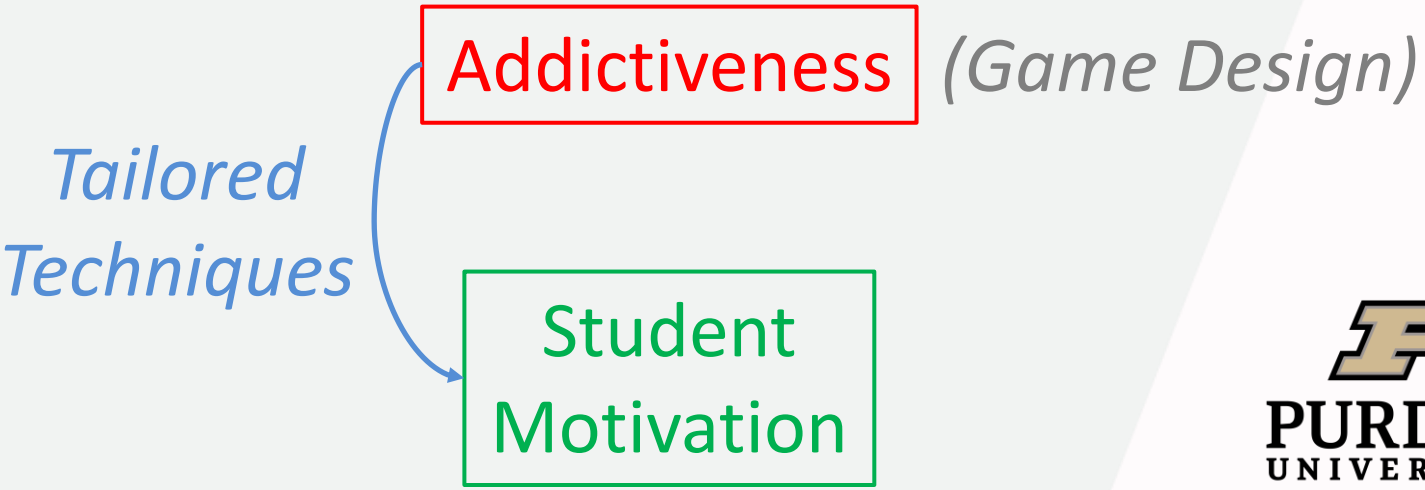

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Topics to cover

- More about Dr. Yaguang Zhang
- Pedagogical philosophy for online education
- Tailored game design techniques
- Applications in digital ag with AGR 333 (Data Science for Agriculture)
- Institutional strategies to lead in future online education

About Dr. Yaguang Zhang

PURDUE UNIVERSITY
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About Dr. Yaguang Zhang

↳ Family name, default setting

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College of Agriculture

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- Ya-
  亚
- guang
  光

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↳ Oracle bone script
(~3000 years ago)

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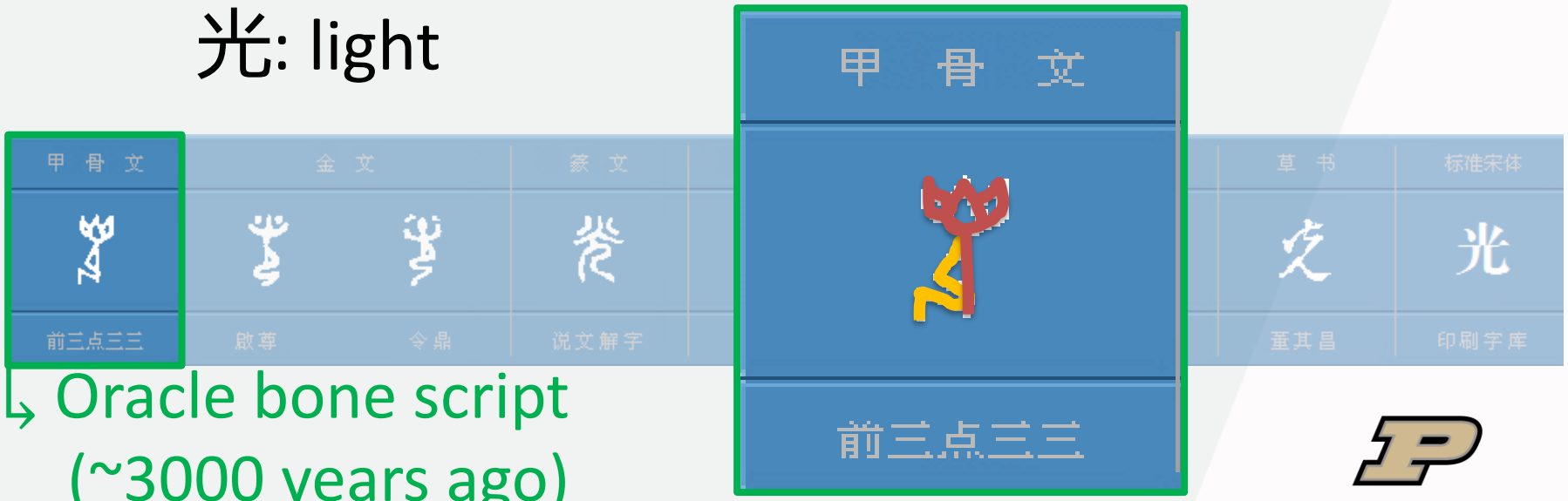

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Stride for excellence to humbly serve others

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Far-fetched?

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Stride for excellence to humbly serve others

Far-fetched?

Still, I choose to interpret my name this way…

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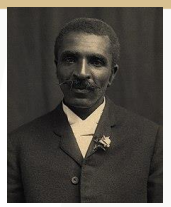
Pedagogical philosophy: Goals

- What kind of students do we want to produce/cultivate?

Education, in the broadest of truest sense, will make an individual seek to help all people, **regardless of race, regardless of color, regardless of condition.**



GEORGE WASHINGTON CARVER

2021-2026 College of Agriculture Strategic Plan

Pedagogical philosophy: Goals

- What kind of students do we want to produce/cultivate?
  1. Motivated to serve others

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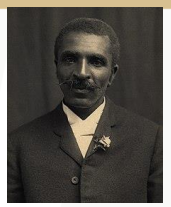
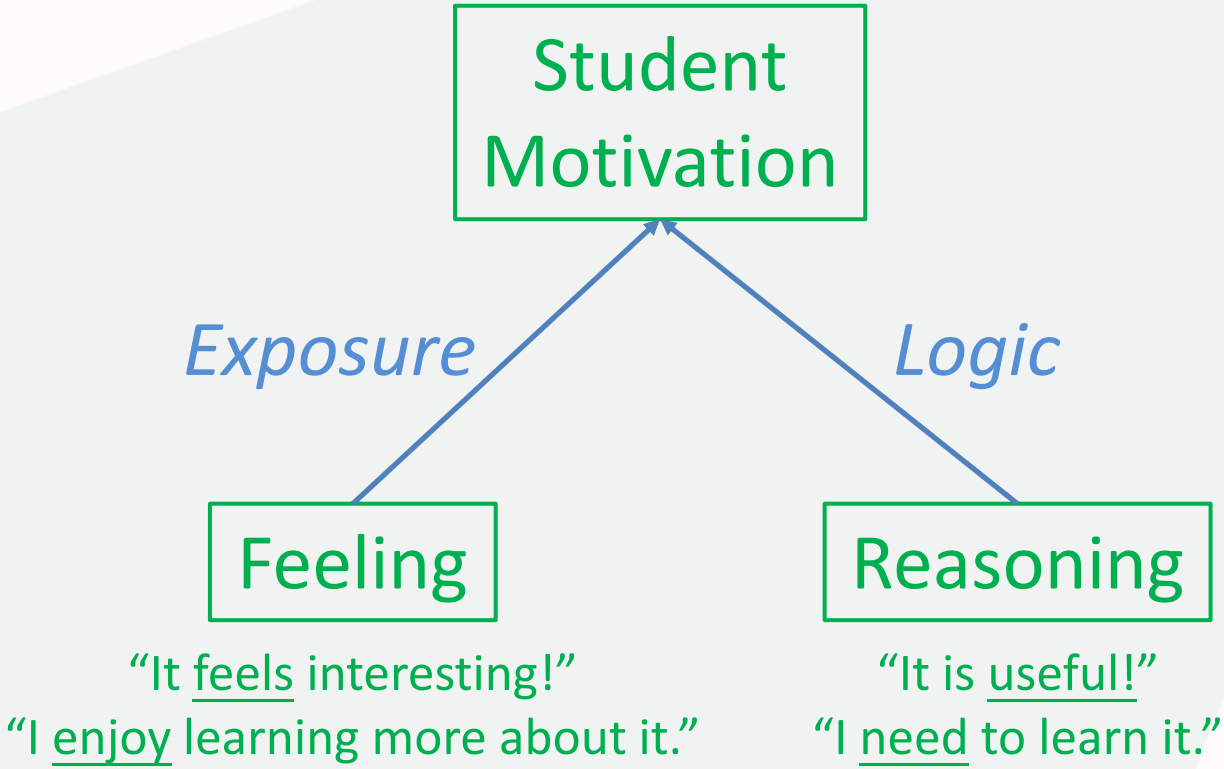


GEORGE WASHINGTON **CARVER**

Pedagogical philosophy: Approaches



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Teaching demo: Optimization

- A framework for guiding/making decisions
  - Data-driven
  - Can be used to set goals for AI
  - Good for AGR 333 - Data Science for Ag

Teaching demo: Optimization

- A framework for guiding/making decisions
- Teaching goals:
  - Optimization is useful
  - Helping others is good

Teaching demo: Optimization

- A framework for guiding/making decisions

$$\min_{x \in A} f(x)$$

Cost function

Feasible region

Action

Teaching demo: Optimization

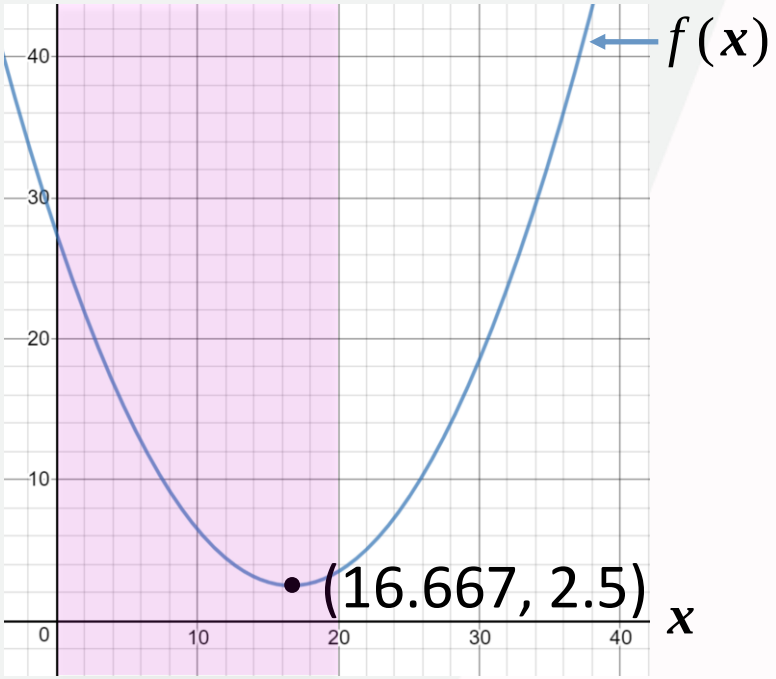
- A framework for guiding/making decisions

$$\arg\min_{x \in A} f(x)$$

Expense - yield

[0, 20]

Fertilizer amount



Example: How much nitrogen fertilizer should we apply?

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Teaching demo: Optimization

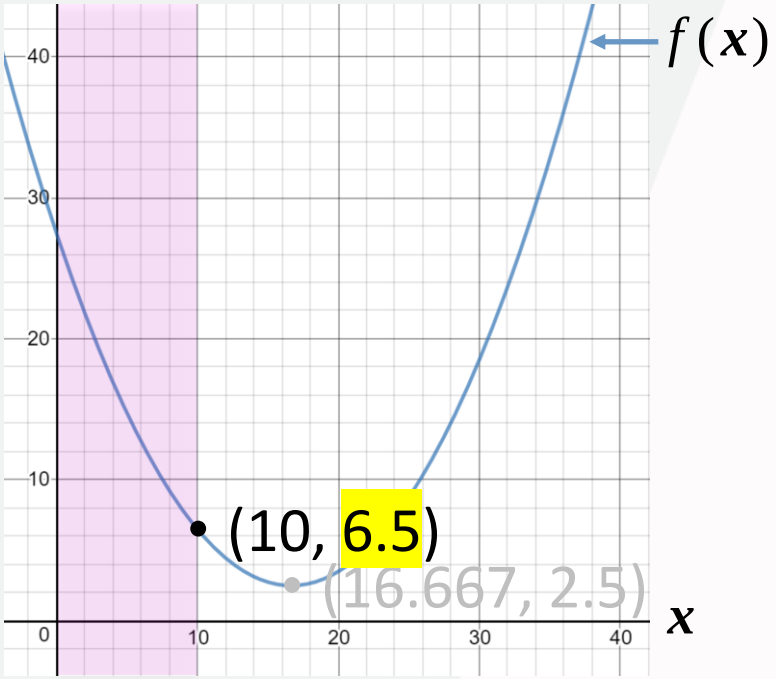
- A framework for guiding/making decisions

$$\arg\min_{x \in A} f(x)$$

$f(x)$: Expense - yield

A: [0, 10]

x: Fertilizer amount



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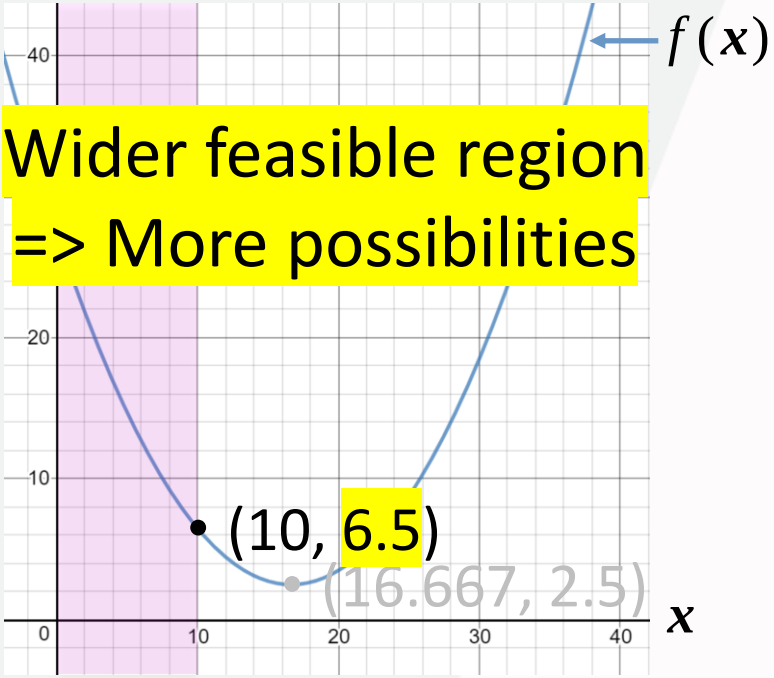

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Teaching demo: Optimization

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Does “helping others” lead to a “better world”?

Teaching demo: Optimization

- A framework for guiding/making decisions

ΣResource – Σ"happiness"

$$\arg\min_{x \in A} f(x)$$

$x \in A$: A high-dimensional region

x: A vector $(x_1, x_2, \ldots)$

Does "helping others" lead to a "better world"?

Teaching demo: Optimization

- A framework for guiding/making decisions

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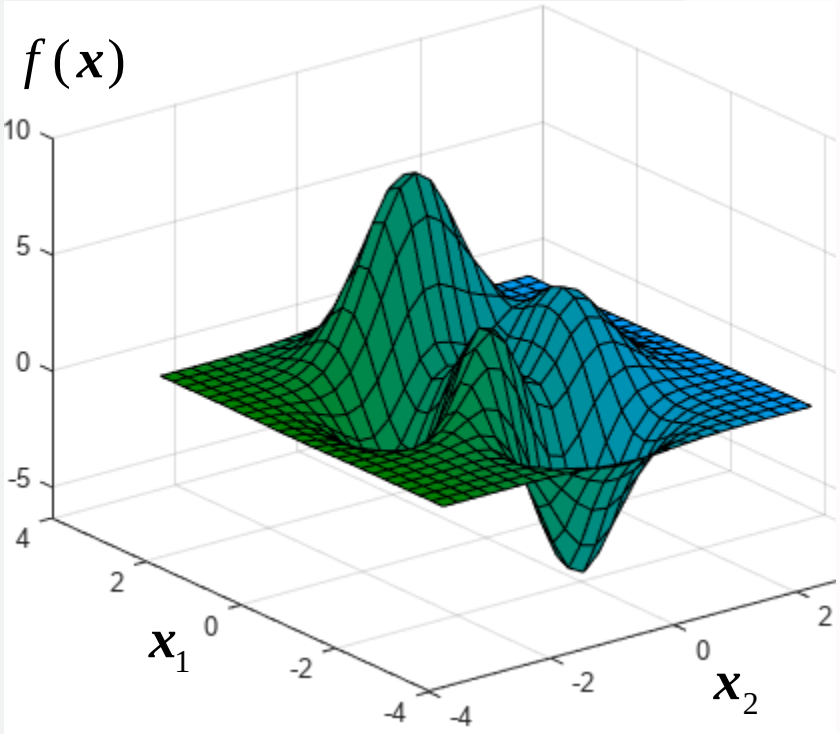

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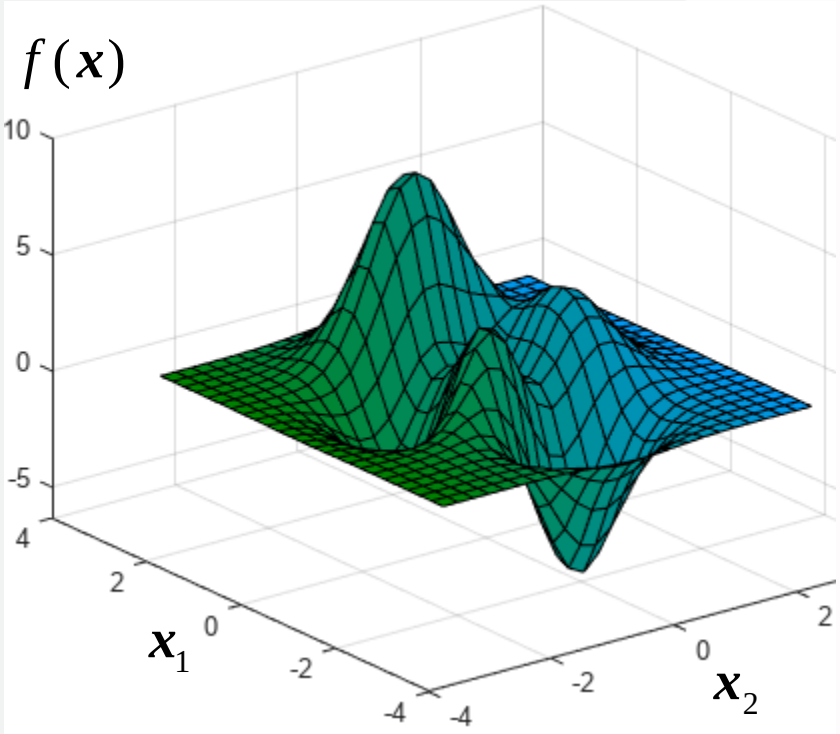
$$A_{\text{Not helping}} \subset A_{\textit{Helping}}$$



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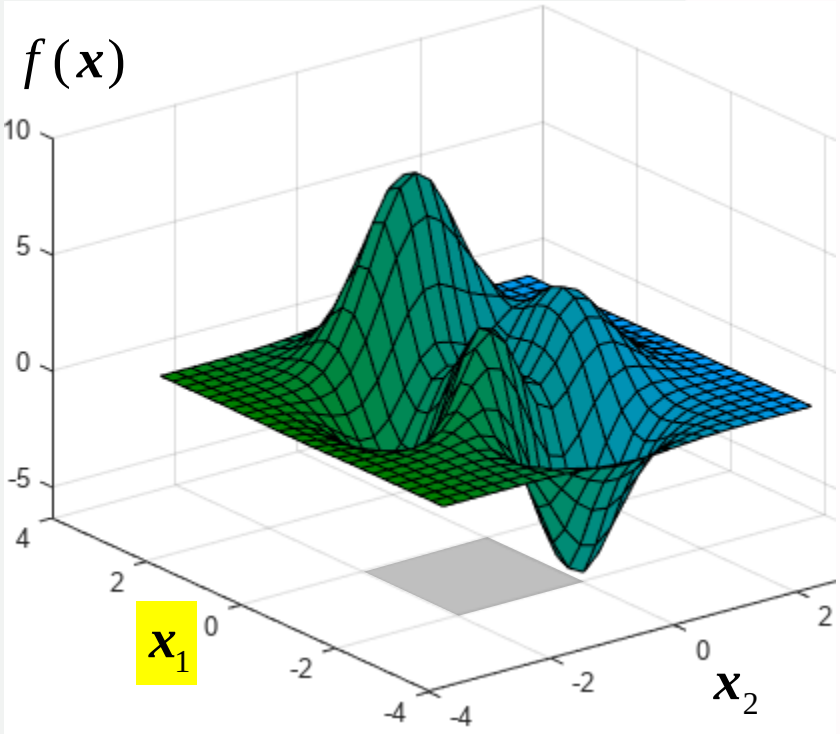

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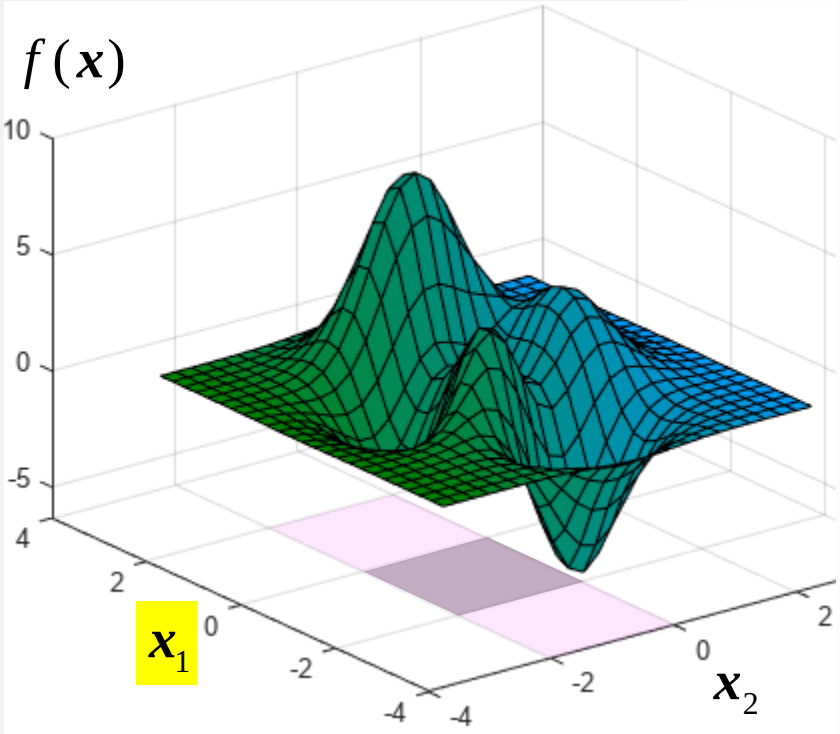

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Teaching demo: Optimization

- A framework for guiding/making decisions

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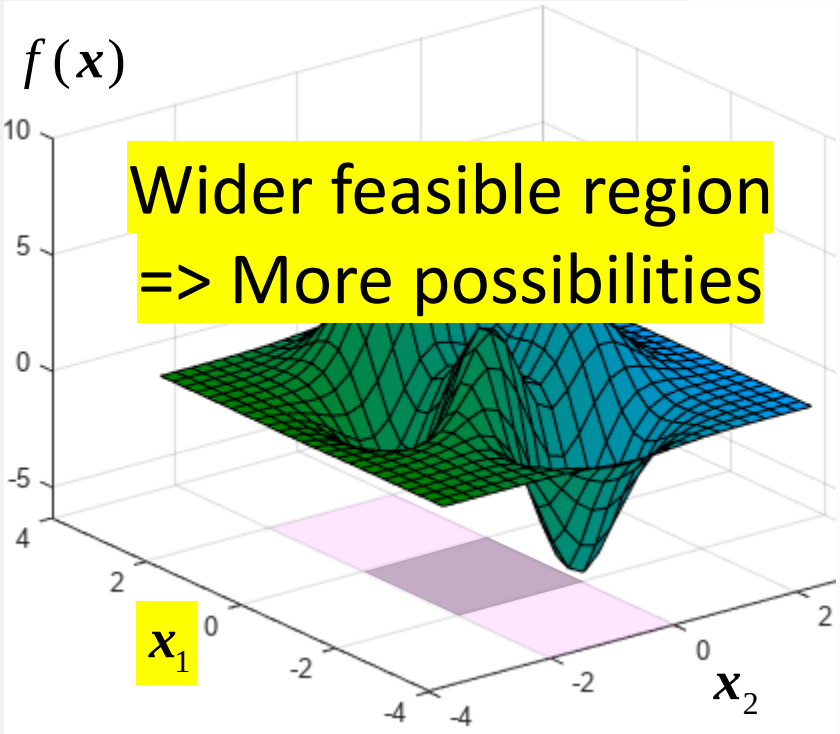
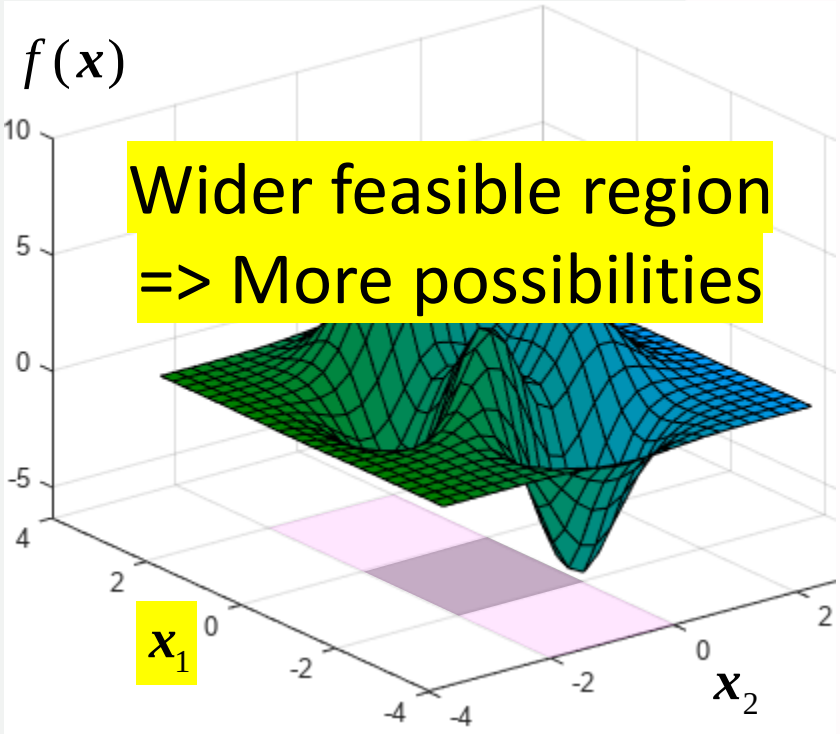


Does "helping others" lead to a "better world"?

Teaching demo: Optimization

- A framework for guiding/making decisions

Implications
- Wider feasible region
  => Better solution
- Equality

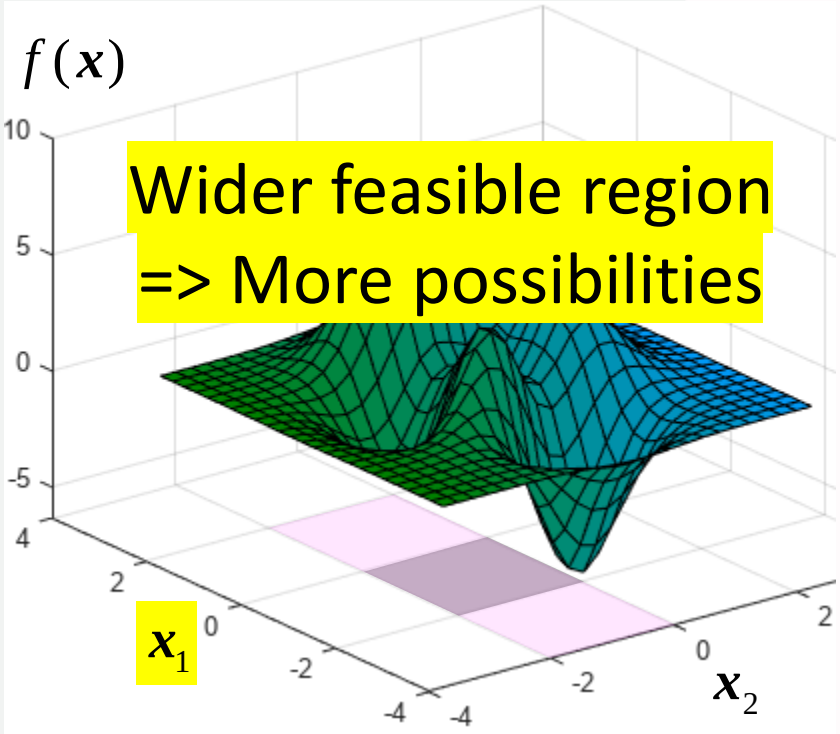


Does “helping others” lead to a “better world”?

Teaching demo: Optimization

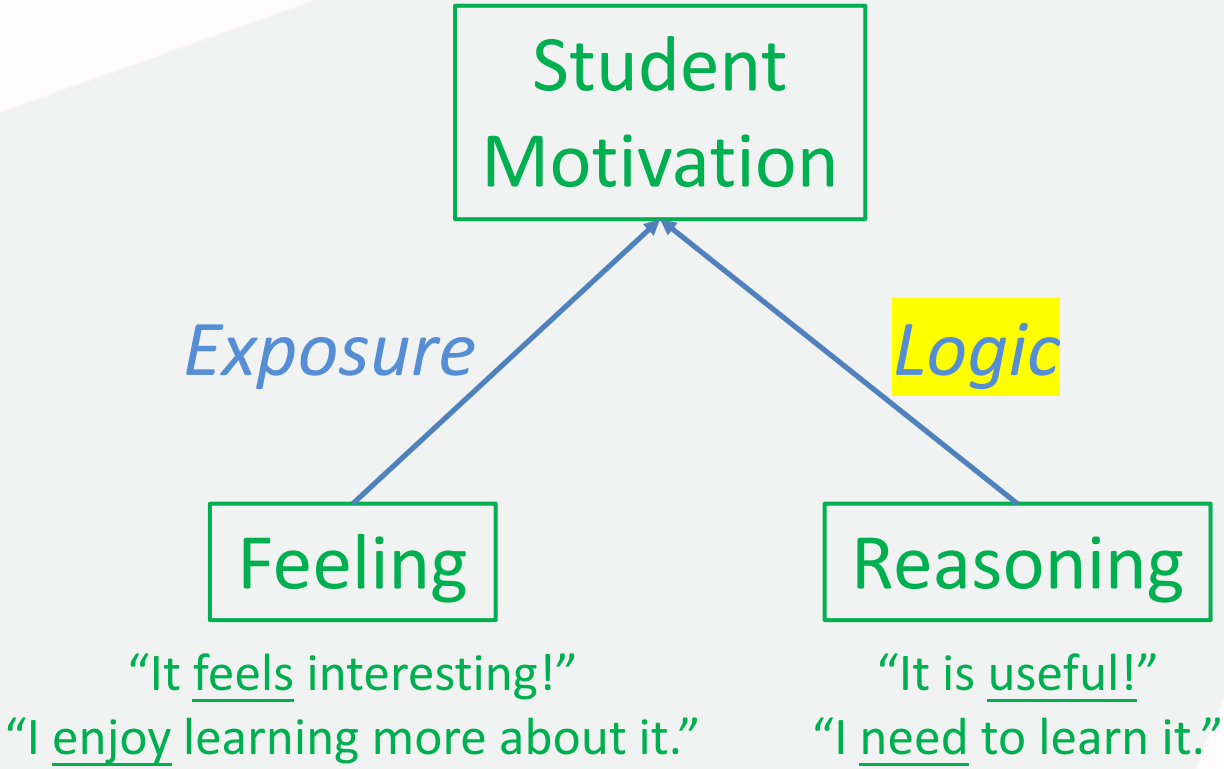
- A framework for guiding/making decisions

Implications
- Wider feasible region
  => Better solution
- Equality
- Example limitations
  1. Quantification
  2. Communication
  3. Computation



Does “helping others” lead to a “better world”?

Pedagogical philosophy: Approaches



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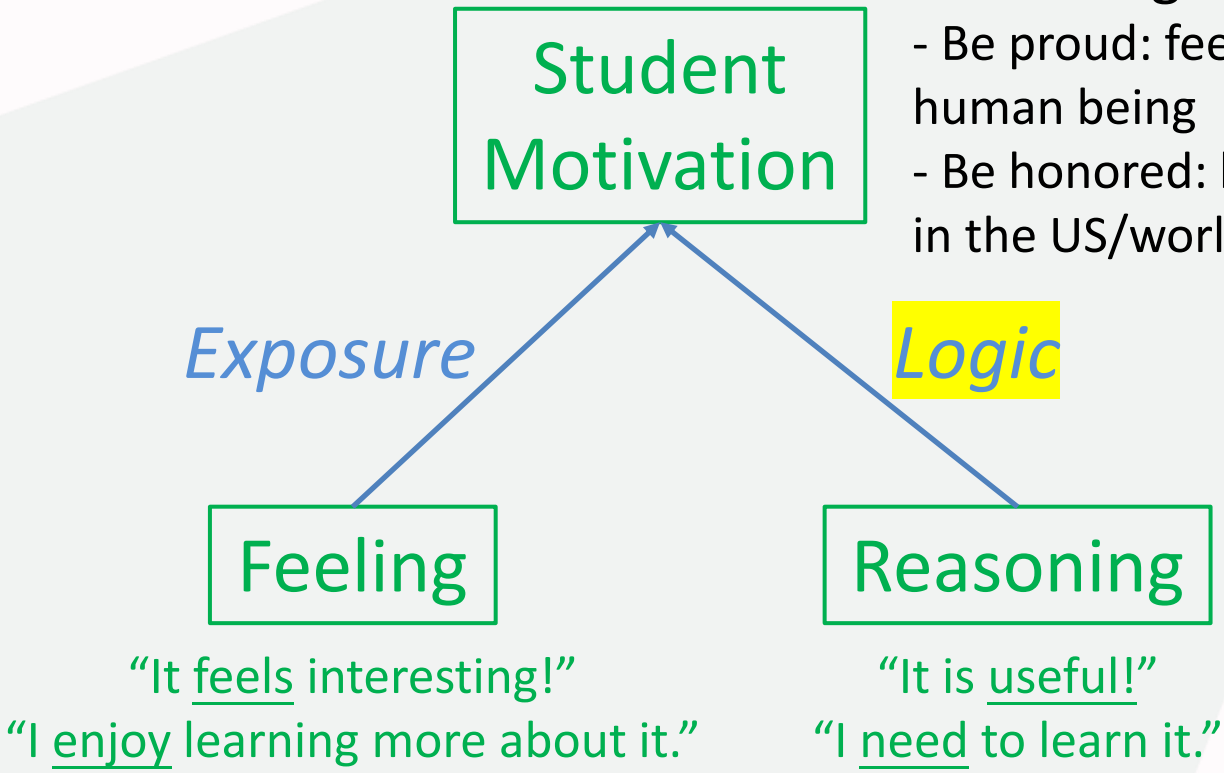
Pedagogical philosophy: Approaches

More examples for Purdue Ag students
- Be proud: feeding the human being
- Be honored: best program in the US/world



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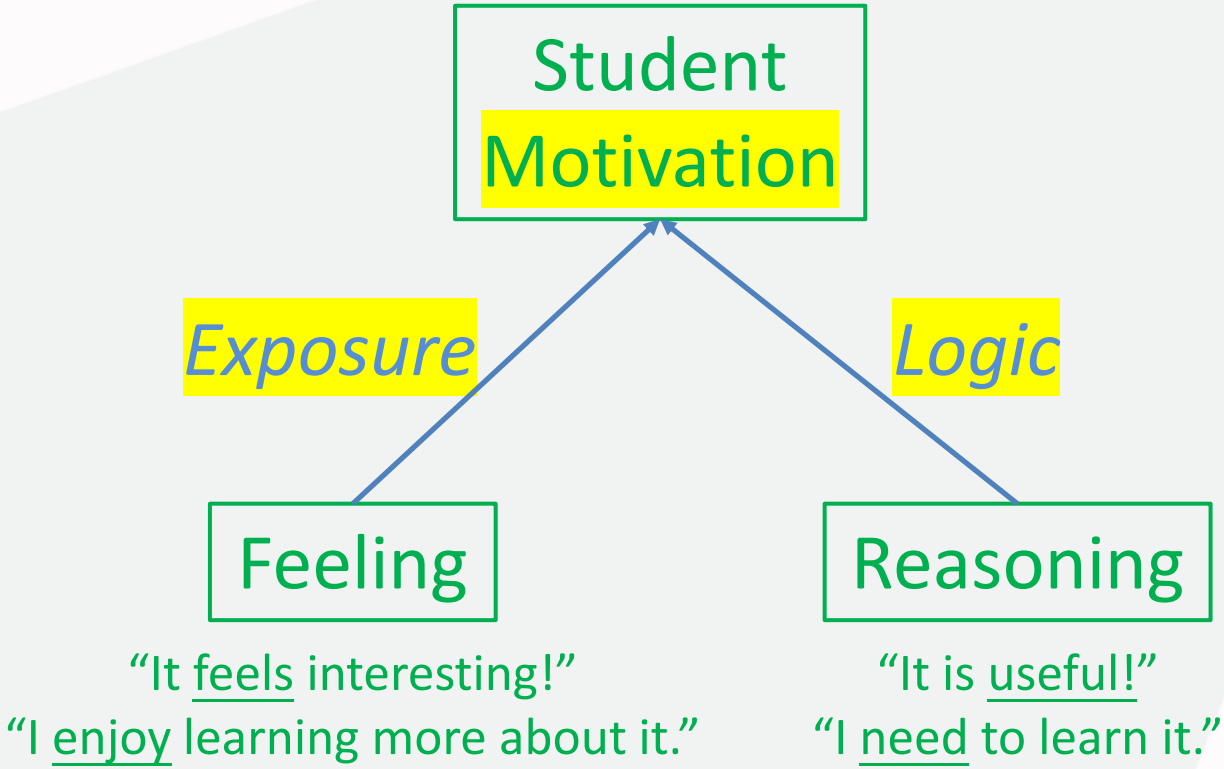
Pedagogical philosophy: Approaches



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Pedagogical philosophy: Goals

- What kind of students do we want to produce/cultivate?
  1. Motivated to serve others
  2. Able to self-learn/apply new skills (Meta skills)
  3. Domain-specific knowledge and skills

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Pedagogical philosophy: Goals

- Reality today?
  1. Focus: Domain-specific knowledge and skills
  2. Byproduct: Meta skills
  3. Slogan: Motivated to serve others

Pedagogical philosophy: Goals

- Reality today?
  1. Focus: Domain-specific knowledge and skills
  2. Byproduct: Meta skills
  3. Slogan: Motivated to serve others
- The world is changing fast
  - Easier access to specific knowledge/skills.

Pedagogical philosophy: Goals

- Reality today?
  1. Focus: Domain-specific knowledge and skills
  2. Byproduct: Meta skills
  3. Slogan: Motivated to serve others
- The world is changing fast
  - Easier access to specific knowledge/skills.
- Implications
  - Students with meta skills => more competitive
  - Instructions focusing on 1 may be replaced

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Human beings are the ultimate judge on life values.

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The world is changing fast.

Creators and developers (vs users) of technology

More about me

- “The best that can be expected of an average student in the modern education system.”
  1. Motivated to serve others
  2. Meta skills
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More about me

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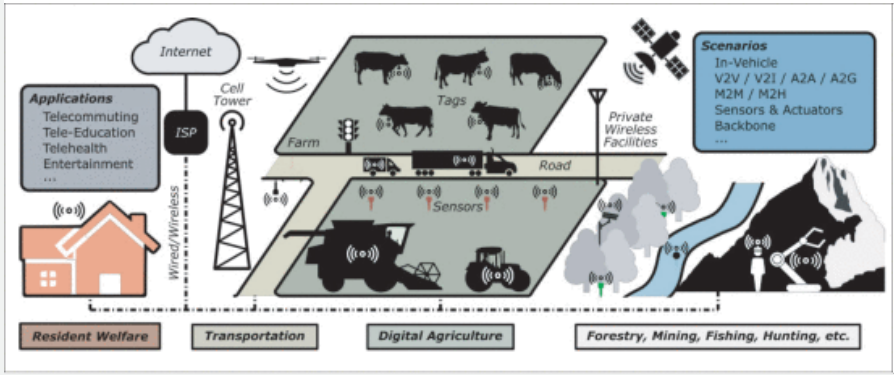
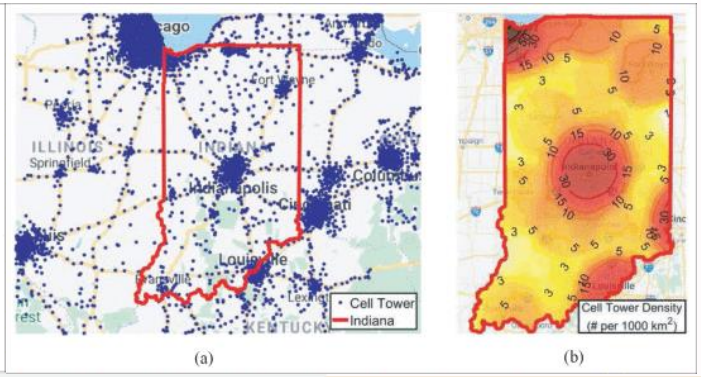
Journals & Magazines > IEEE Communications Magazine > Volume: 59 Issue: 12

Challenges and Opportunities of Future Rural Wireless Communications

Publisher: IEEE Cite This PDF

Yaguang Zhang ; David J. Love ; James V. Krogmeier ; Christopher R. Anderson ; Robert W. Heath ; Dennis R. Buckmaster All Authors





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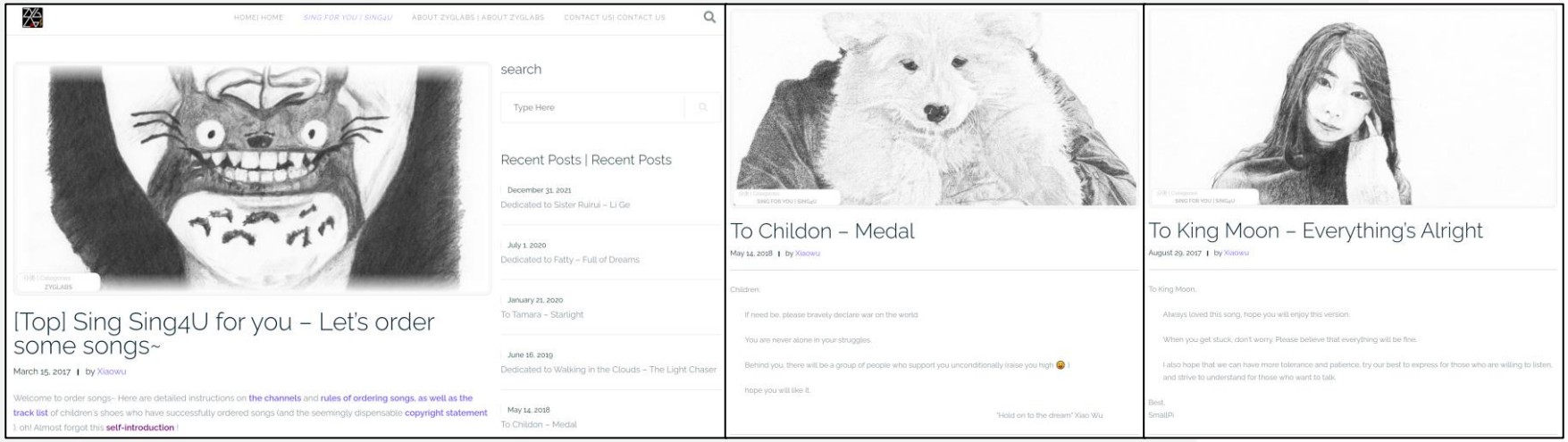

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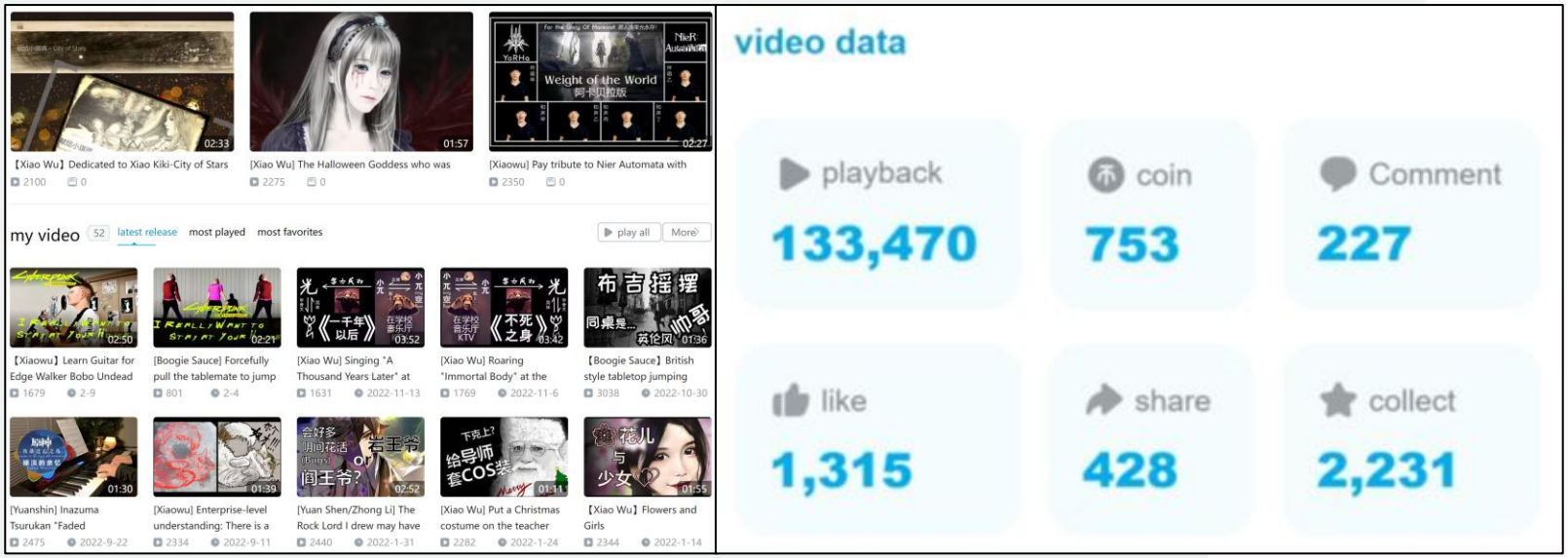

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- Drawing
- Painting
- Guitar
- Piano

- Singing
- Video editing
- Audio editing
- Web development

More about me

- “The best that can be expected of an average student in the modern education system.”
  1. Motivated to serve others
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What has made me who I am today?

How to duplicate the good characteristics?

More about me

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  - Not brilliant, but hard-working

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What has made me who I am today?

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  - Not brilliant, but hard-working
- Exposed to challenges and opportunities

How to duplicate the good characteristics?

Earn the trust

Encourage students to explore

More about me

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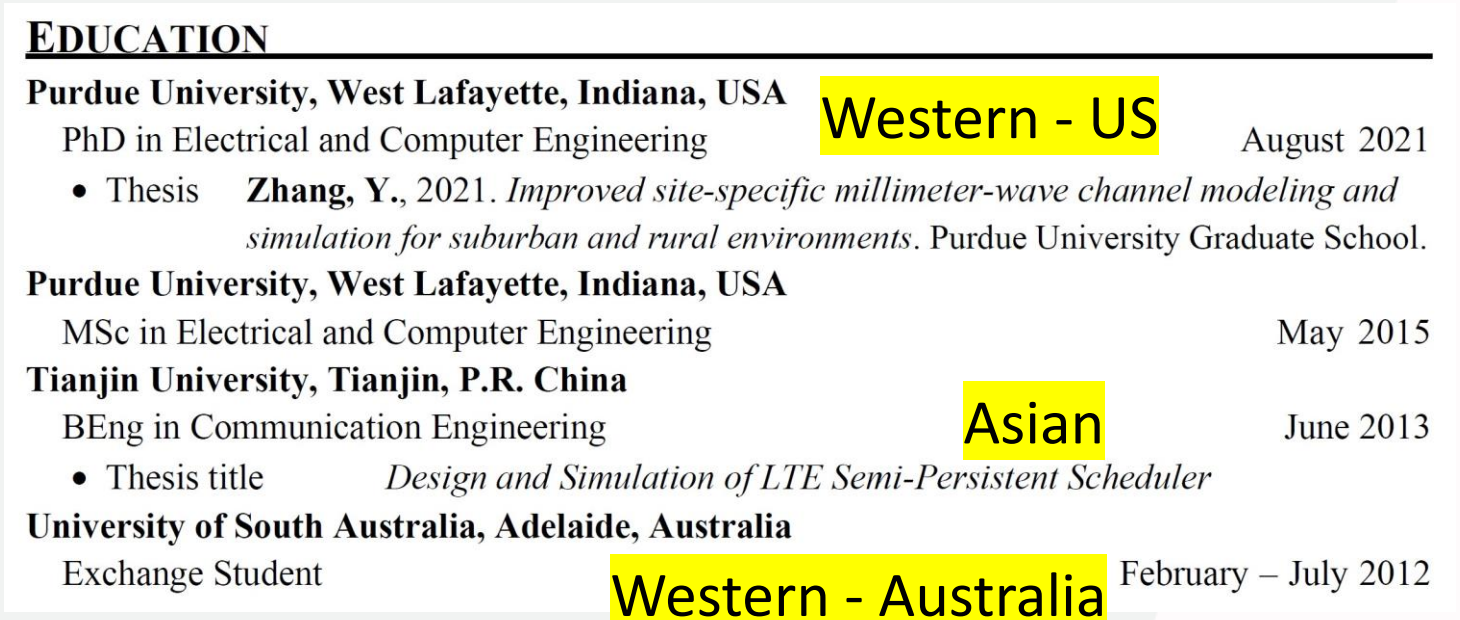


EDUCATION

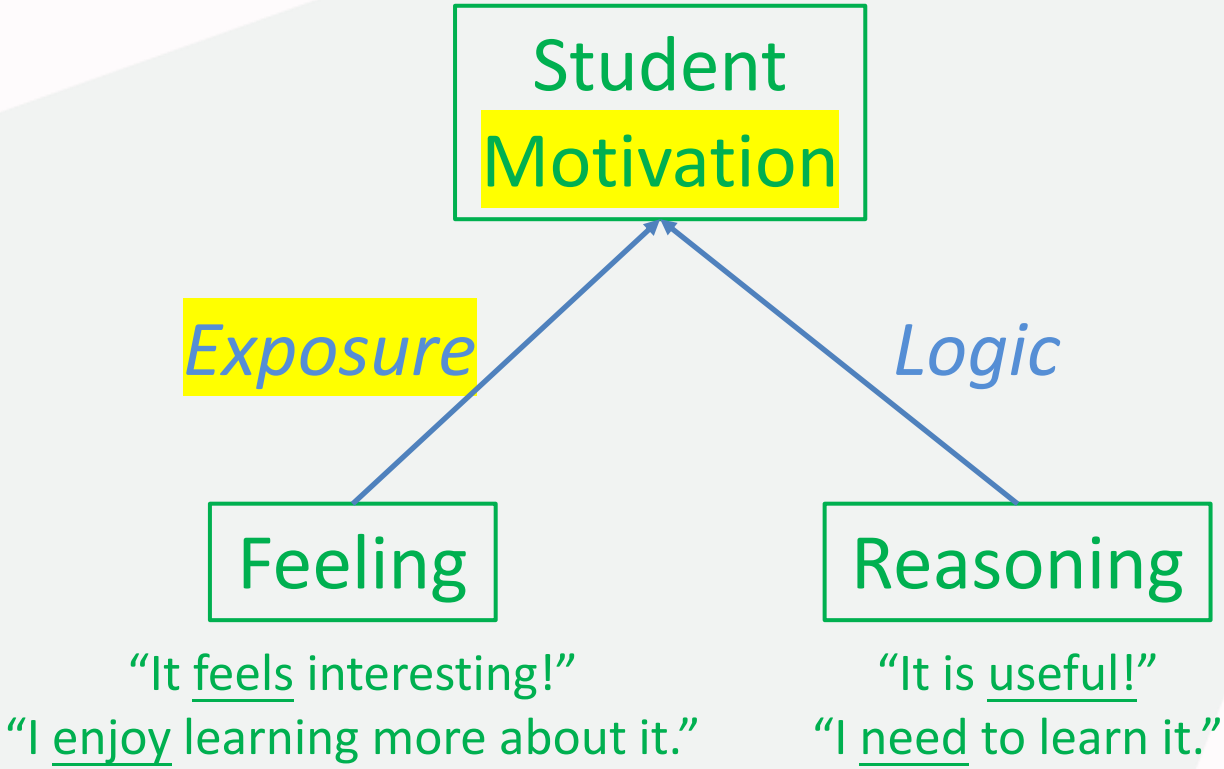
Purdue University, West Lafayette, Indiana, USA
PhD in Electrical and Computer Engineering — August 2021
- Thesis **Zhang, Y.**, 2021. *Improved site-specific millimeter-wave channel modeling and simulation for suburban and rural environments*. Purdue University Graduate School.

Purdue University, West Lafayette, Indiana, USA
MSc in Electrical and Computer Engineering — May 2015

Tianjin University, Tianjin, P.R. China
BEng in Communication Engineering — June 2013
- Thesis title *Design and Simulation of LTE Semi-Persistent Scheduler*

University of South Australia, Adelaide, Australia
Exchange Student — February – July 2012

Pedagogical philosophy: Approaches



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College of Agriculture

Why online education?

July 2011. **Volunteer Teacher**. Jiantang Village Elementary School, Fenghuang County, Hunan Province, China.

- *College Student Summer Service Program*: Taught at a Hope Project school and co-authored a report on local economy and education.

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- A supplement (a cheaper alternative)
- A practical remedy for undeveloped areas

Pedagogical philosophy: Emerging challenges

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- Who are we (as online educators) competing with?

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- Who are we (as online educators) competing with?
  - Online entertainment

Deliberately designed by experts to be addictive

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- What are we competing for?
  - Next generation's attention

A limited resource for keeping ideas

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Useful ideas vs fun ideas

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Rethinking “best practices” in online education

- The world is changing fast
  - Common practices today are probably not best practices in the future

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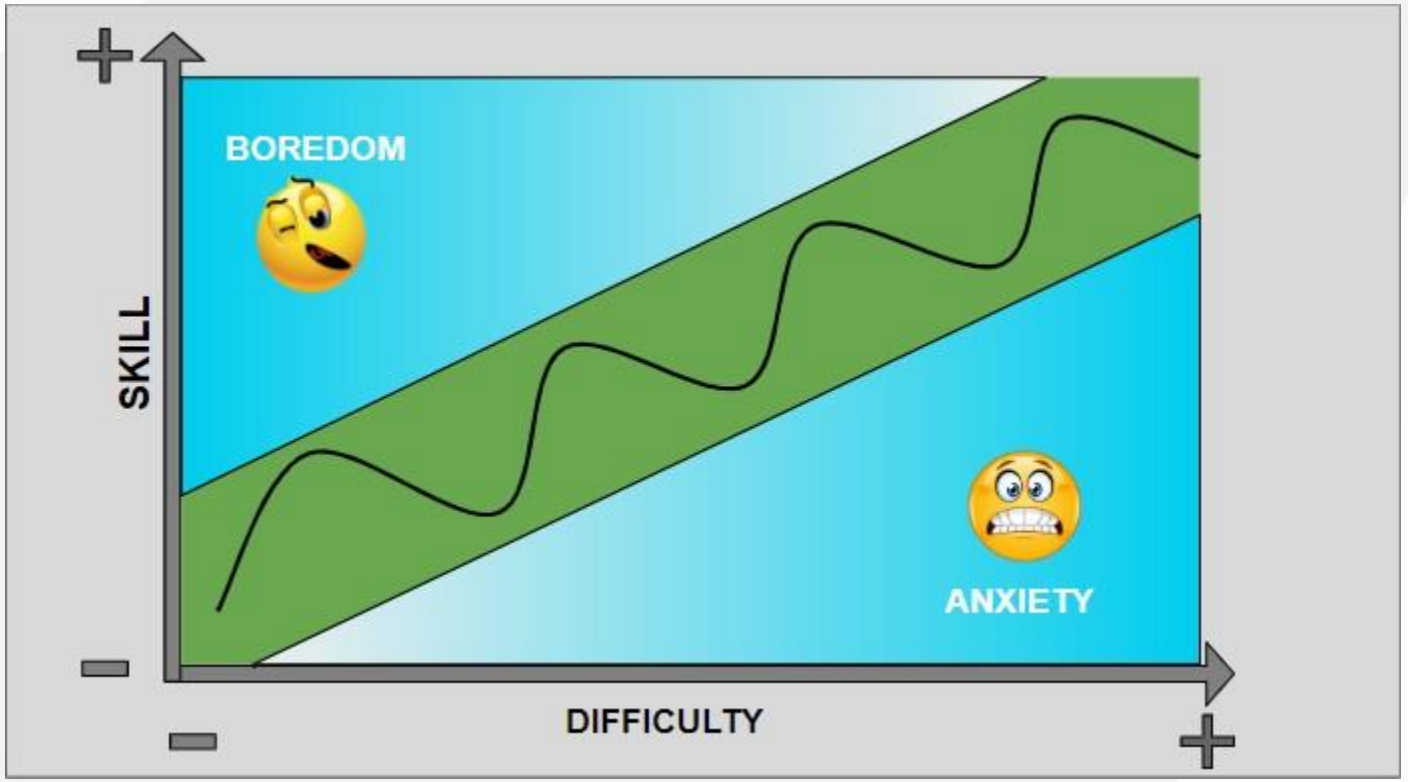
Rethinking “best practices” in online education

- The world is changing fast
  - Common practices today are probably not best practices in the future
  - Proposal, implementation, evaluation, and promotion of “better practices”
- Candidates for better practices?
  - Most successful training tool: games
  - Most useful education content: real-life skills

Game design

- The “flow” state



https://thinkgamedesign.com/flow-theory-game-design/

Selected game design techniques

- Flow (as a rough guideline)
  - Progress control
  - Challenges
- Intuitive visual hints
- Frequent positive feedback
  - Points/virtual currency
  - Achievements
- Real-time preformation evaluation
- The power of habits
  - Daily/weekly/monthly missions

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- Huge amount of content
- Beta tests
- User survey
- High-quality arts (both visual and audio)
- Trailers/ads
- Localization (e.g., multi-language)
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Let's be do whatever we can to help students learn more easily?

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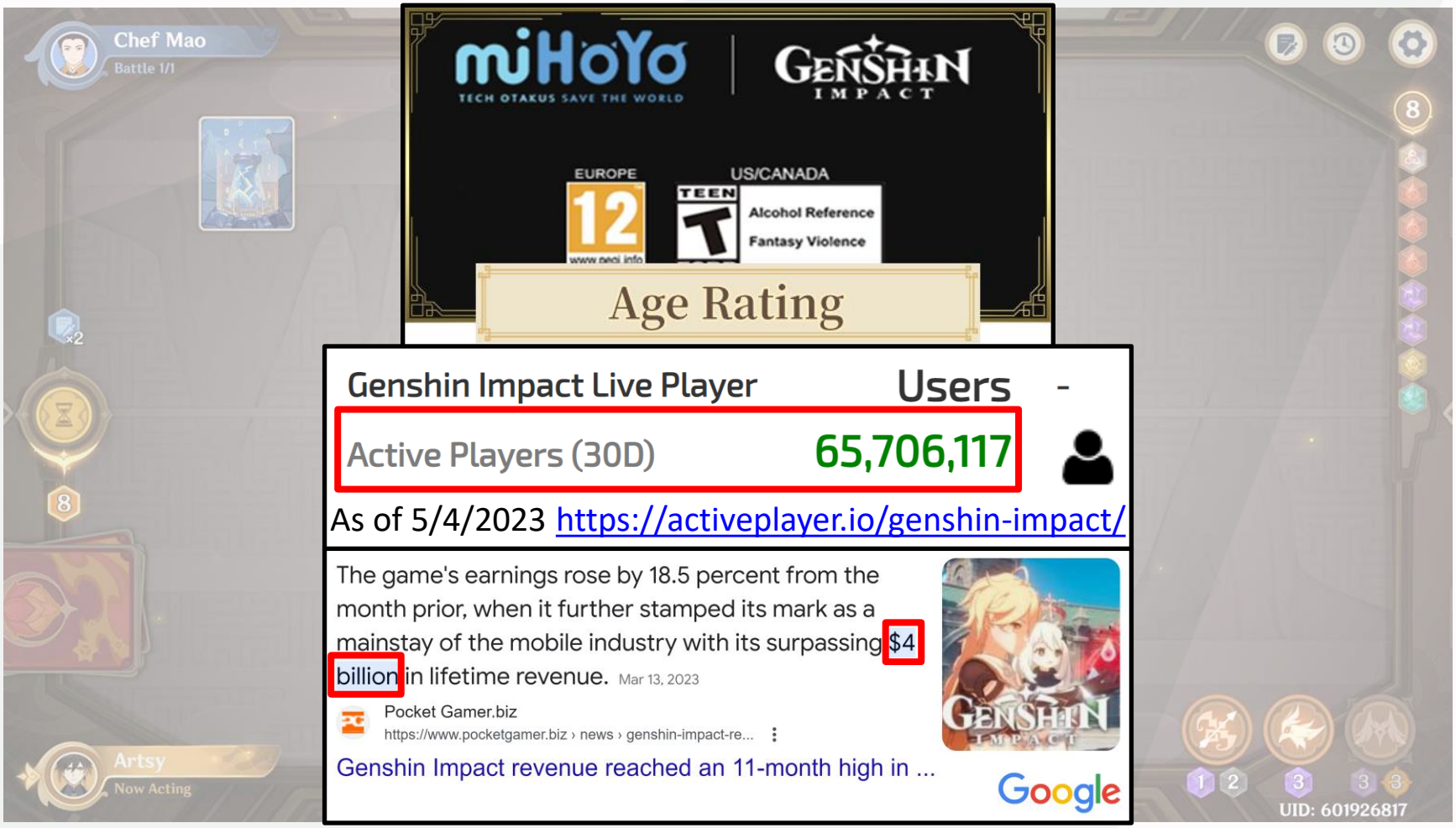

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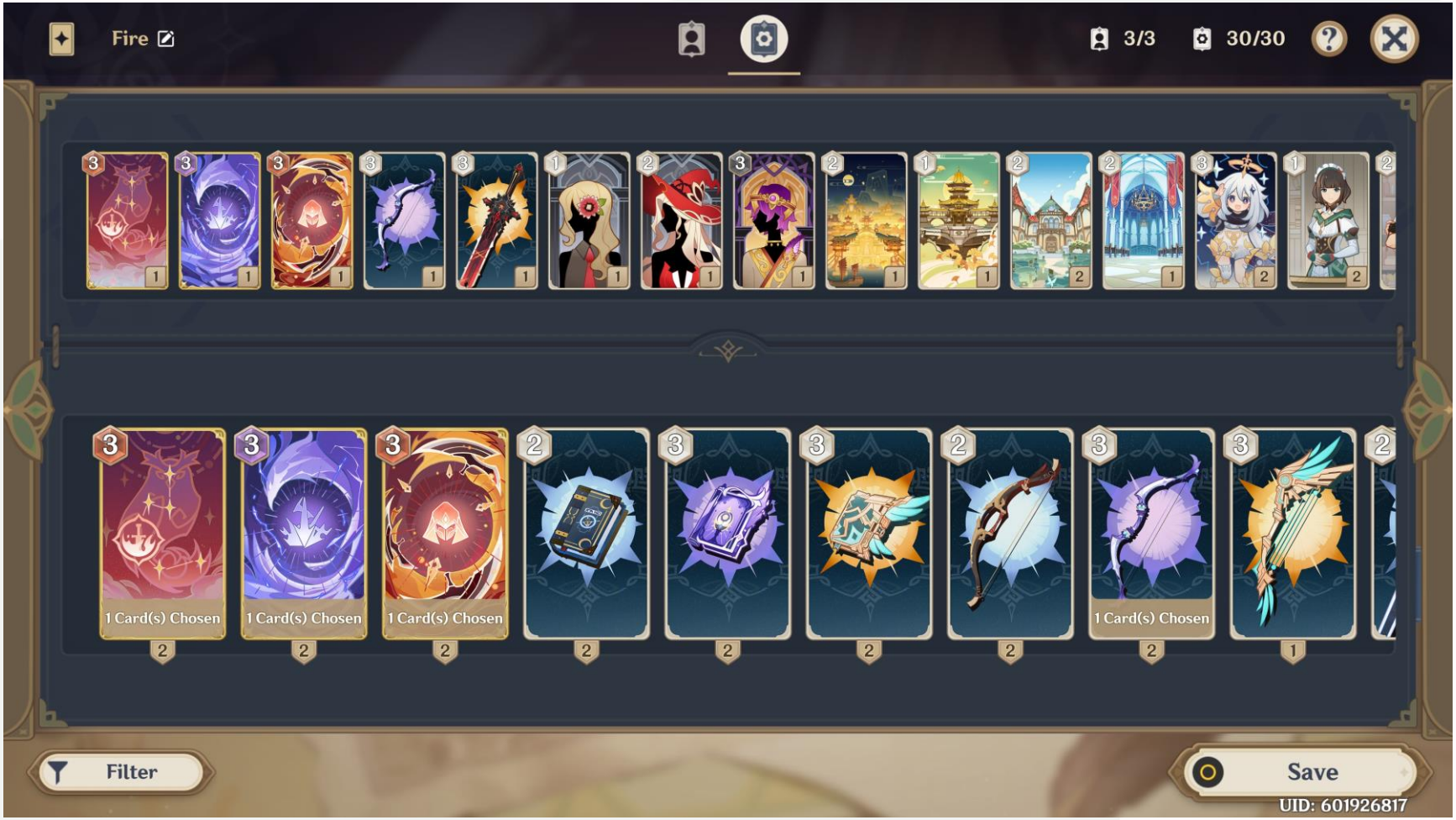

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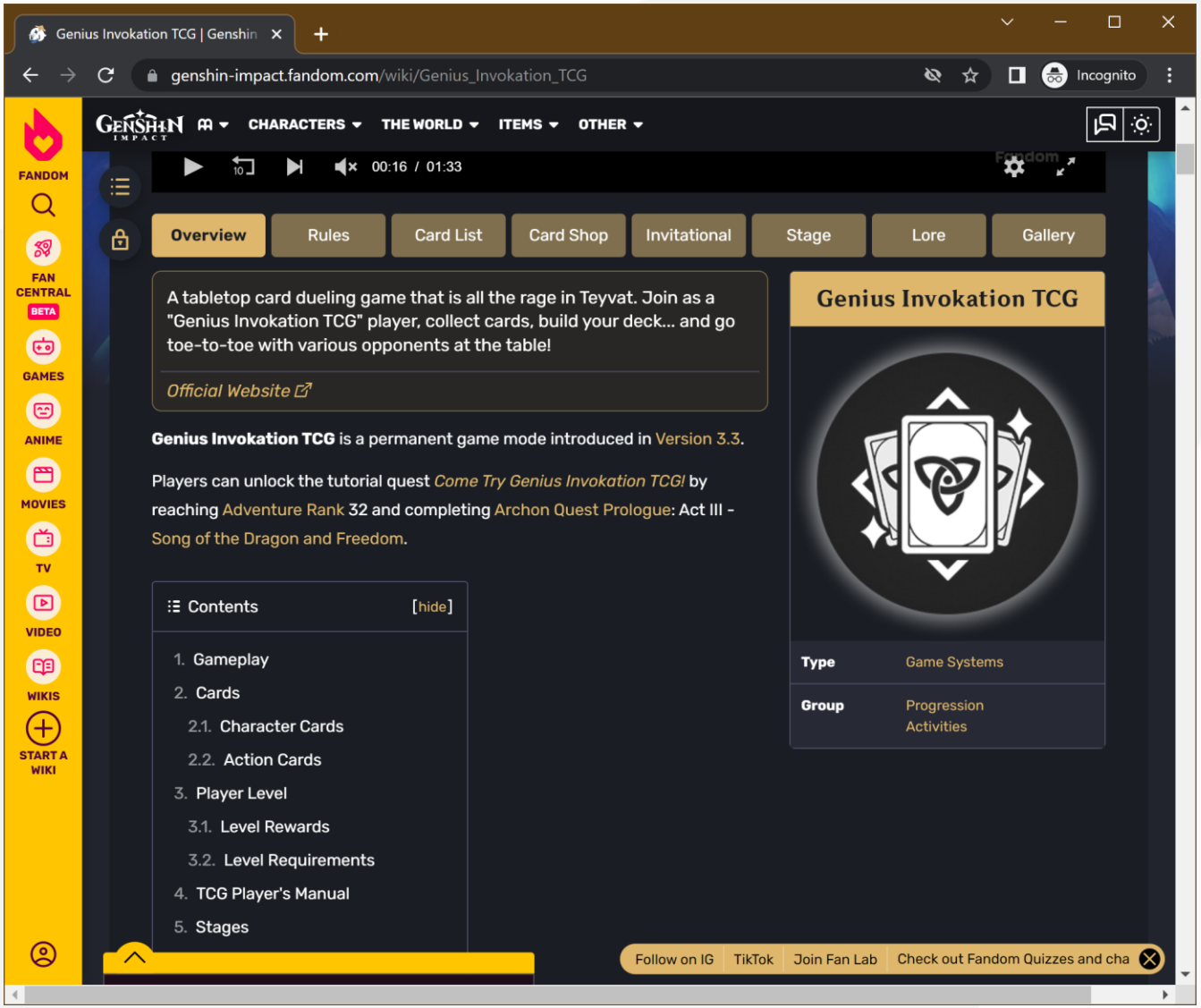

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Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Rough guidelines
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Data-driven decision-making: Optimization

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Data collection & processing: Digital signal processing
Data-driven decision-making: Optimization

Live demo for digital signal processing

- Extremely good example for intuition
  - Sensors => Microphone
  - Data => Sampled & quantized air pressure
  - Processing => In time & frequency
- Easy access + “tangible”

Live demo for digital signal processing

- Extremely good example for intuition
  - Sensors => Microphone
  - Data => Sampled & quantized air pressure
  - Processing => In time & frequency
- Easy access + “tangible” + interesting
- Teach the skill first + cover the topics

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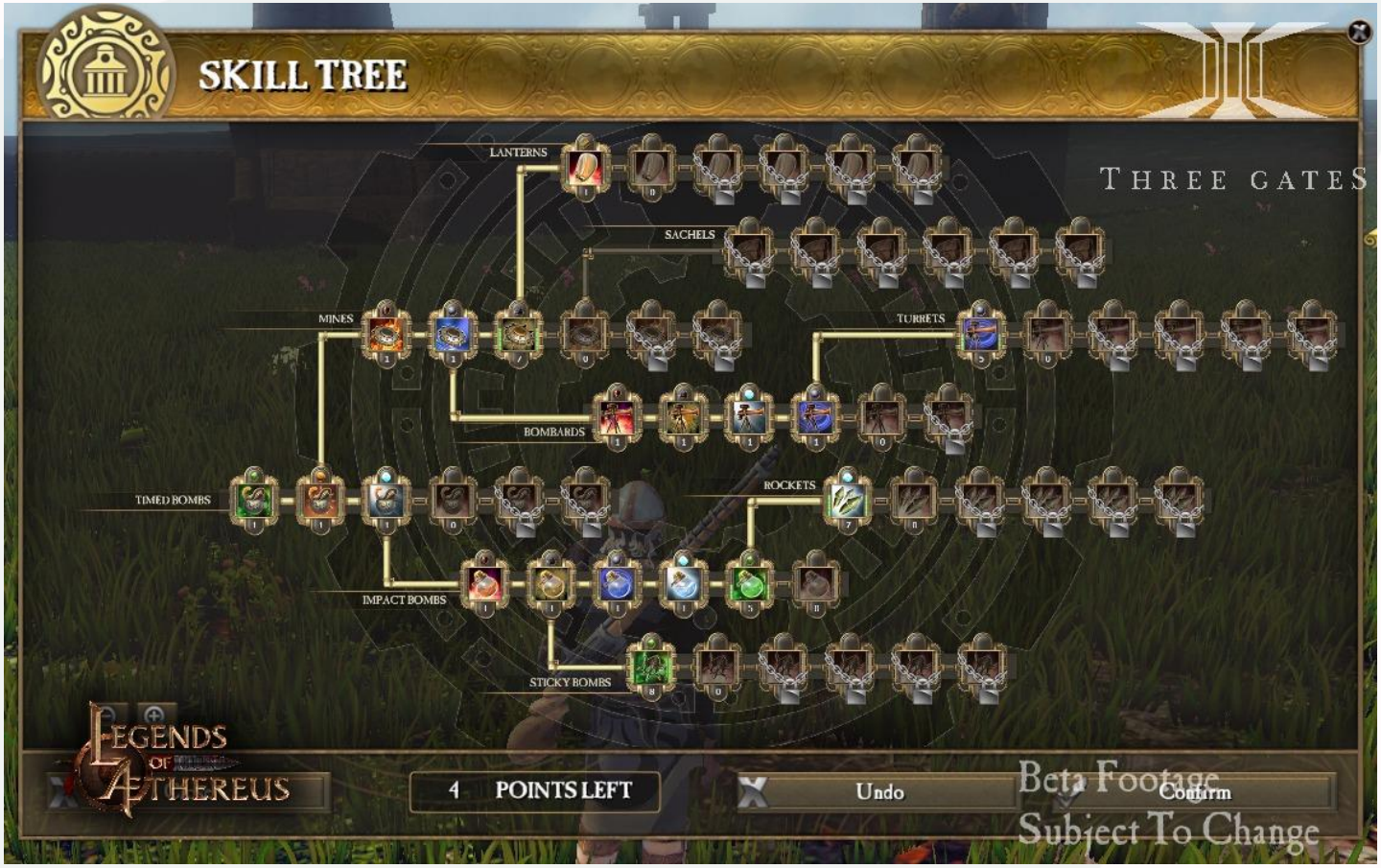
  - Skill tree

Tailoring game design techniques for AGR 333 - Data Science for Agriculture

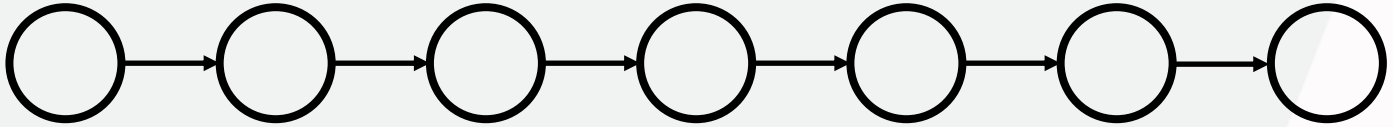
- Skill tree – Non-linear structure



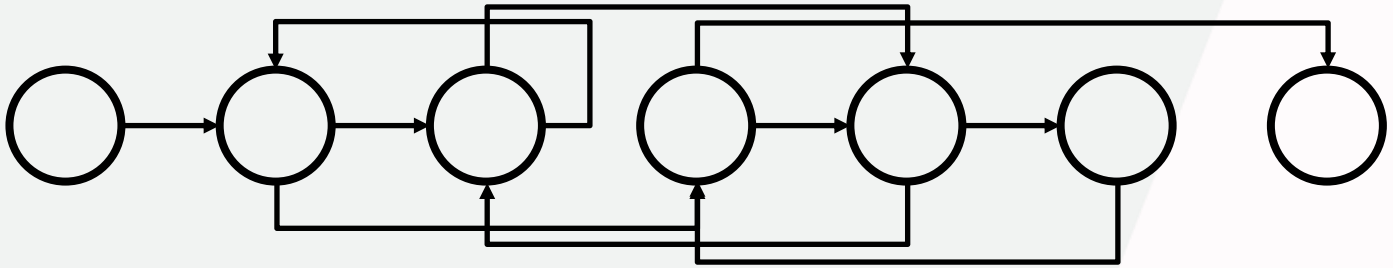
Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Skill tree – Non-linear structure
  - Why do we need a “non-linear” structure?

Traditional teaching: topics covered once are assumed to be mastered by the students.



Fact: repetition is required for learning.



Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Skill tree – Non-linear structure

Add a new column

	Date	Skill	Topic	Details	Quizzes and Assignments
WK 1: INTRO	Recorded		Faculty Introductions		
	Jan 10 Class		Orientation to data cycle, with an overview of all processes, FAIR concept. Volume, veracity, velocity		
	Jan 12 Lab		Beginning to work with data	Import of CSV into Excel & R with some statistical computations	
2-3: FOOD SCIENCE, FENG	Recorded		Food Science Applications		
	Jan 17 Class		Identify a research question Identify data needed		
	Jan 19 Lab		Working with Food Science data	Introduce multiple data files, including consumption, Pesticide residue, EPA RPF references	
	Jan 24 Class		Ethics of data (ownership, storage, access)		
	Jan 26 Lab		Food Science data	Conduct cumulative risk assessment of organophosphate (OP) pesticide group for this population.	

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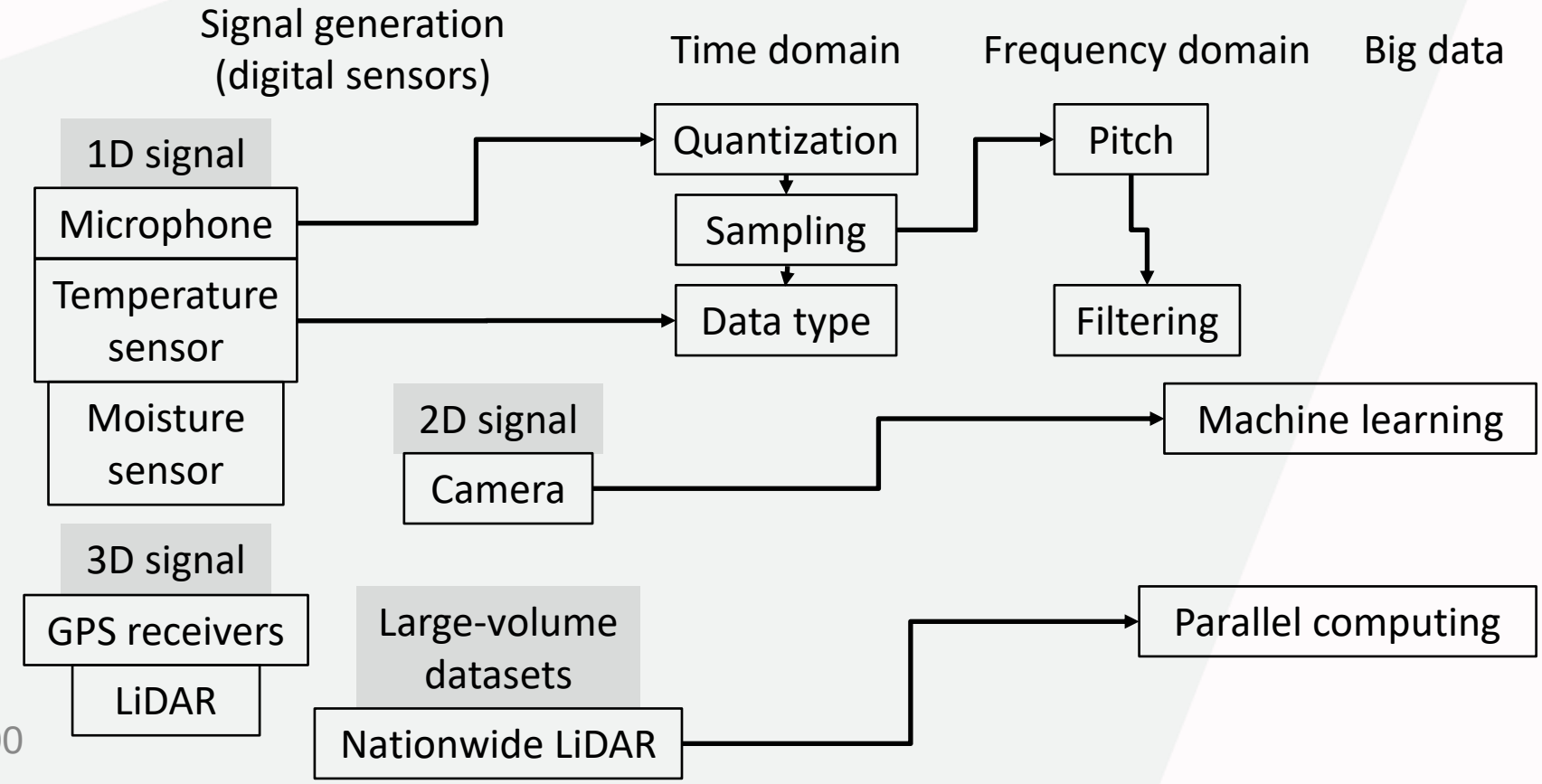

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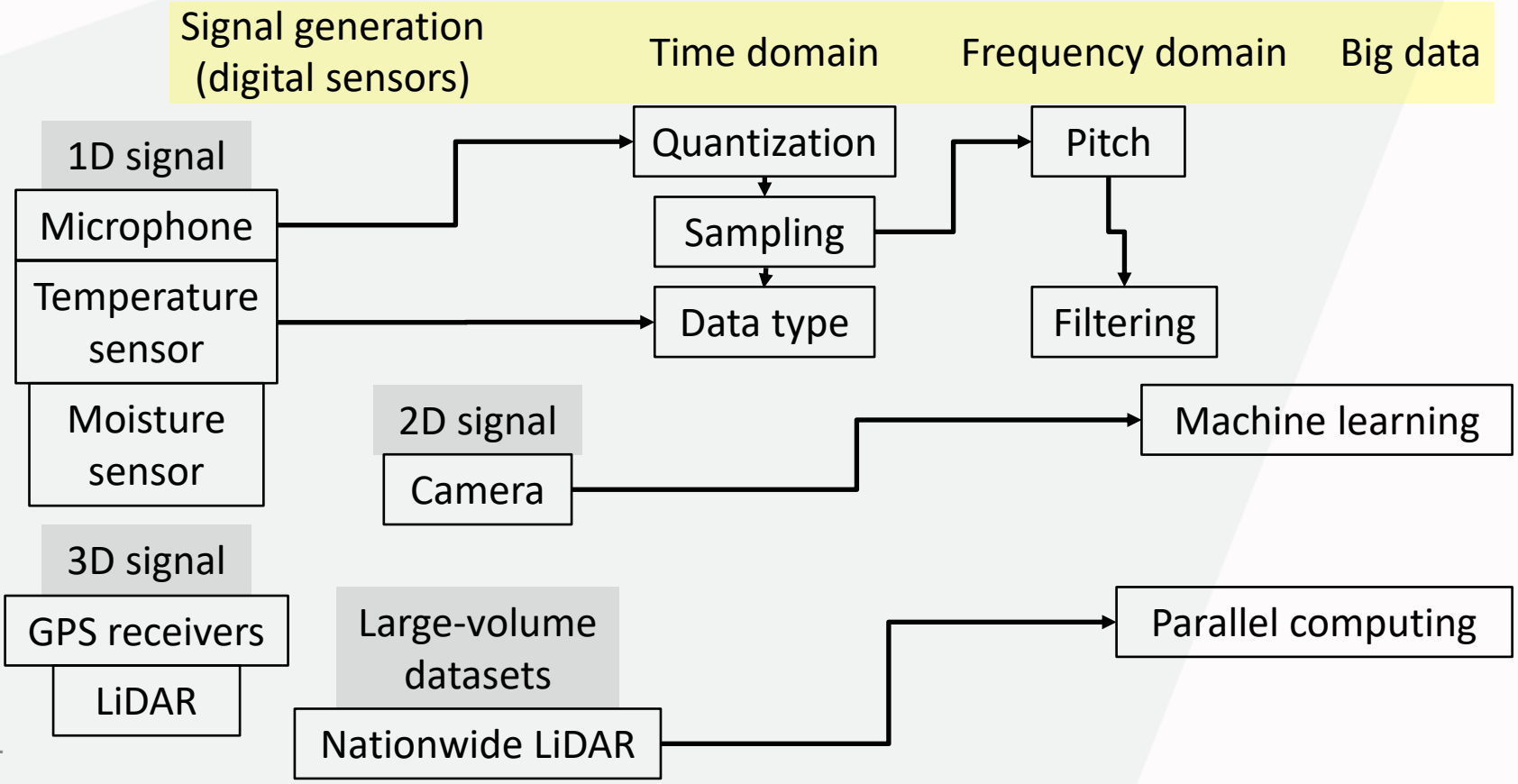

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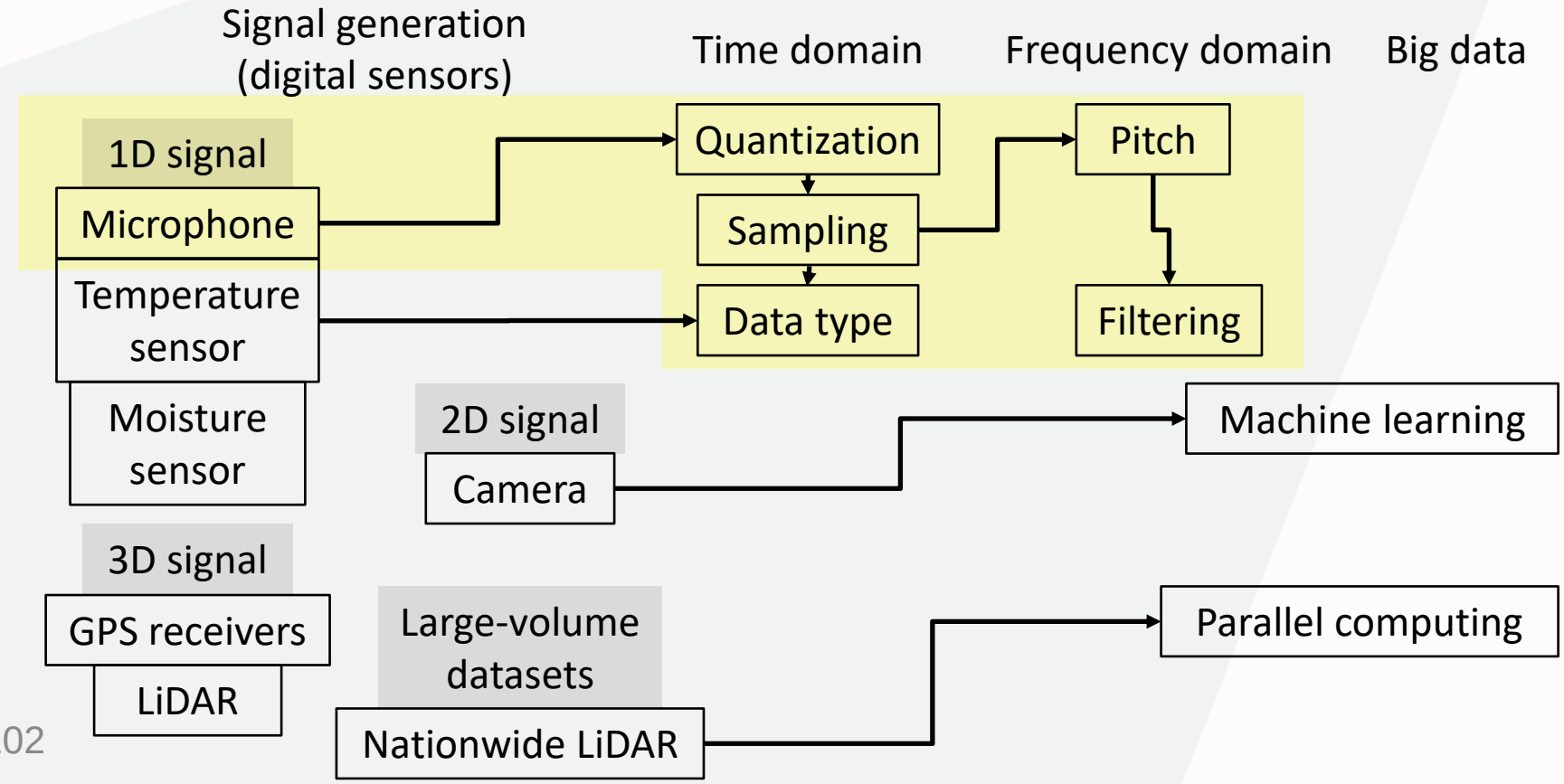

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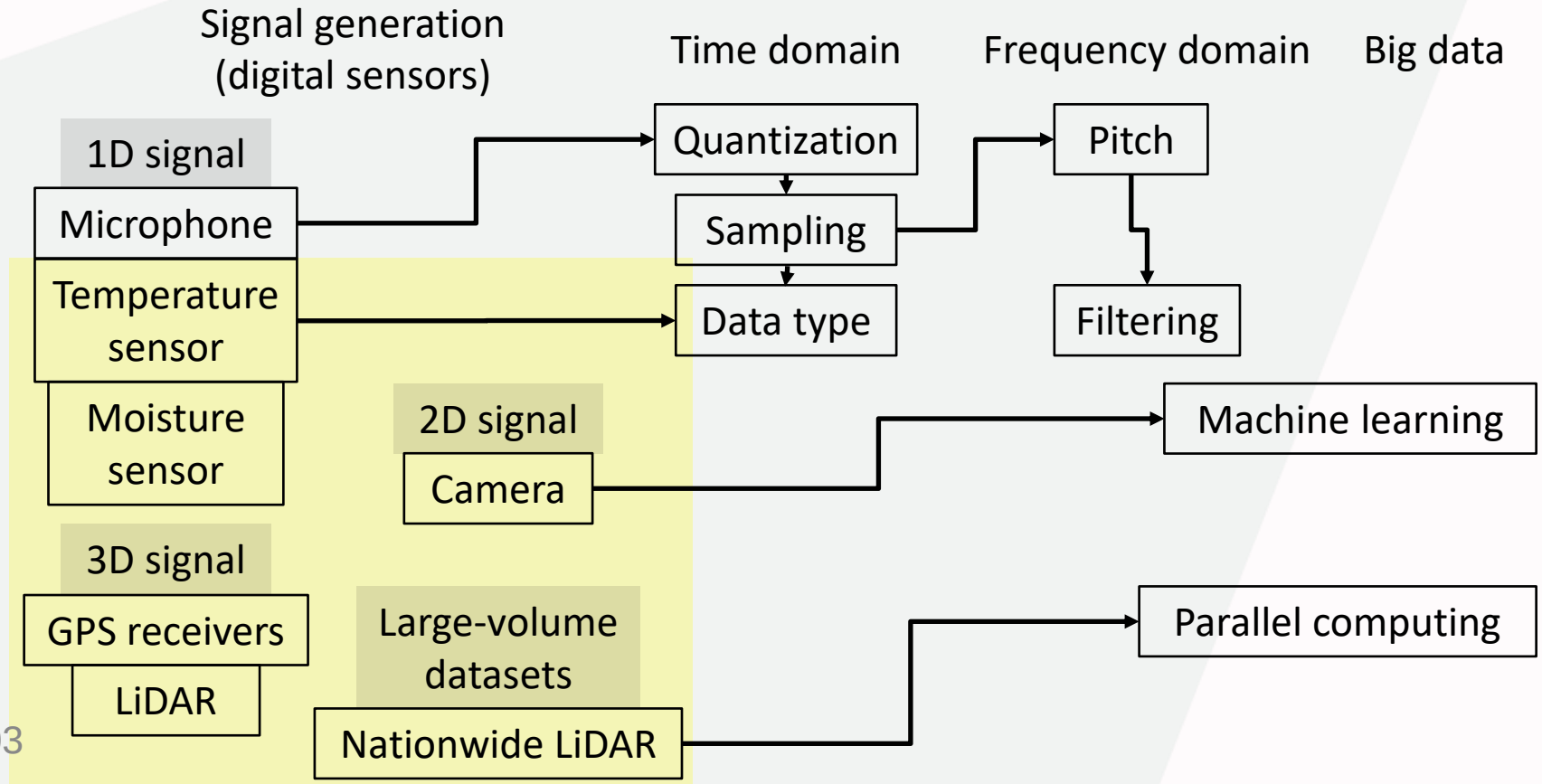

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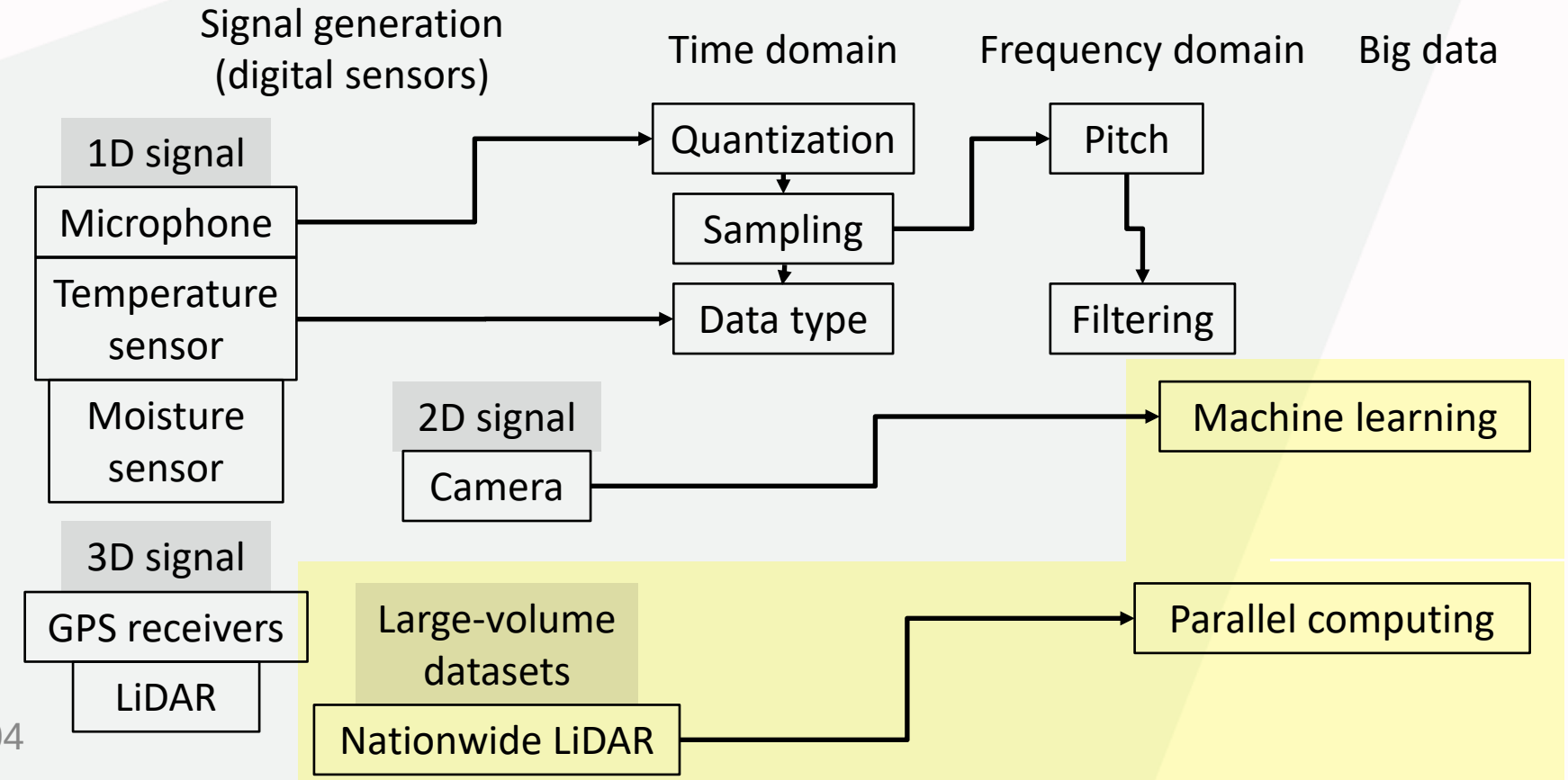

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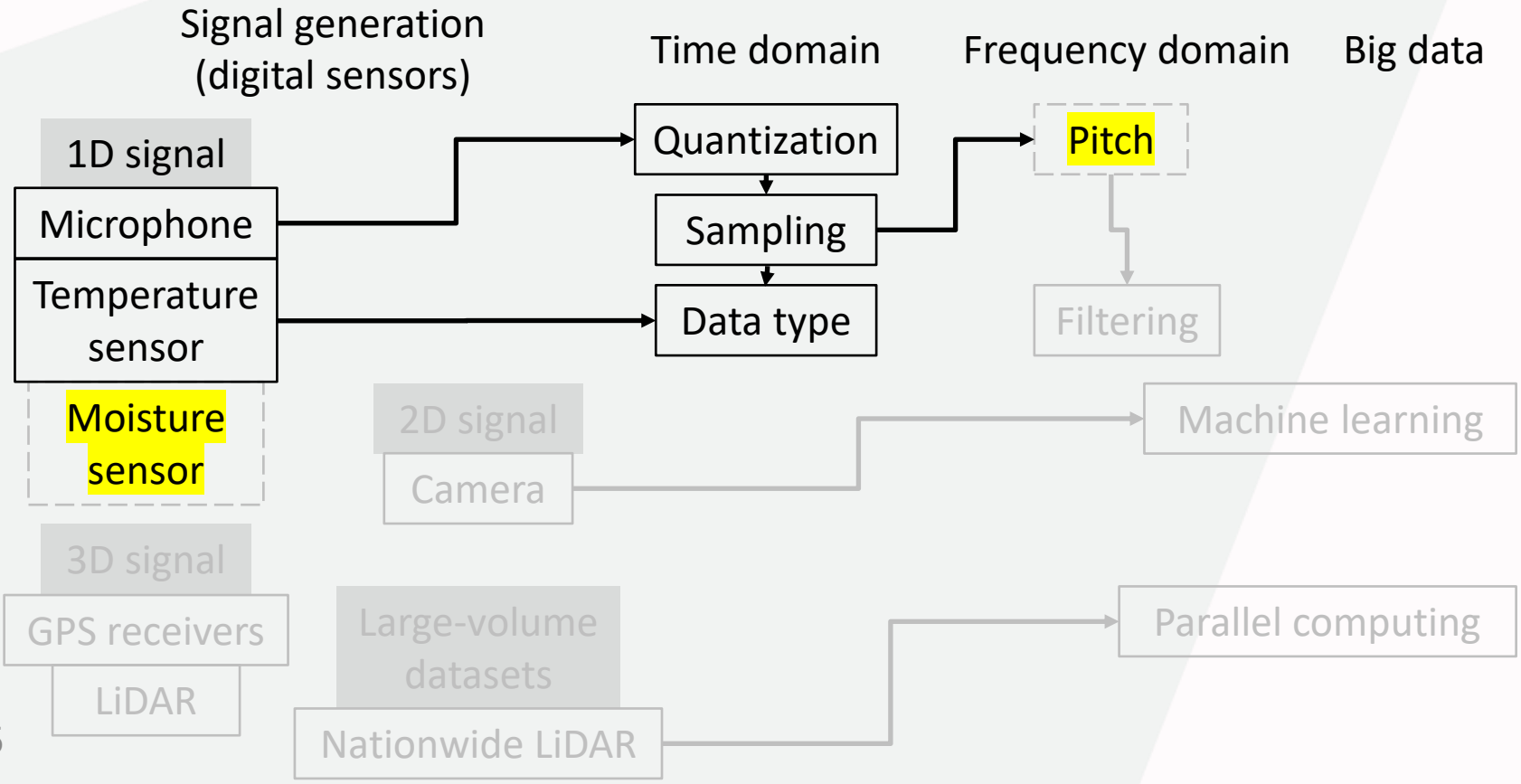

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- Rough guidelines
  - The “flow” state
  - Huge amount of content for all levels with progress control and rewards
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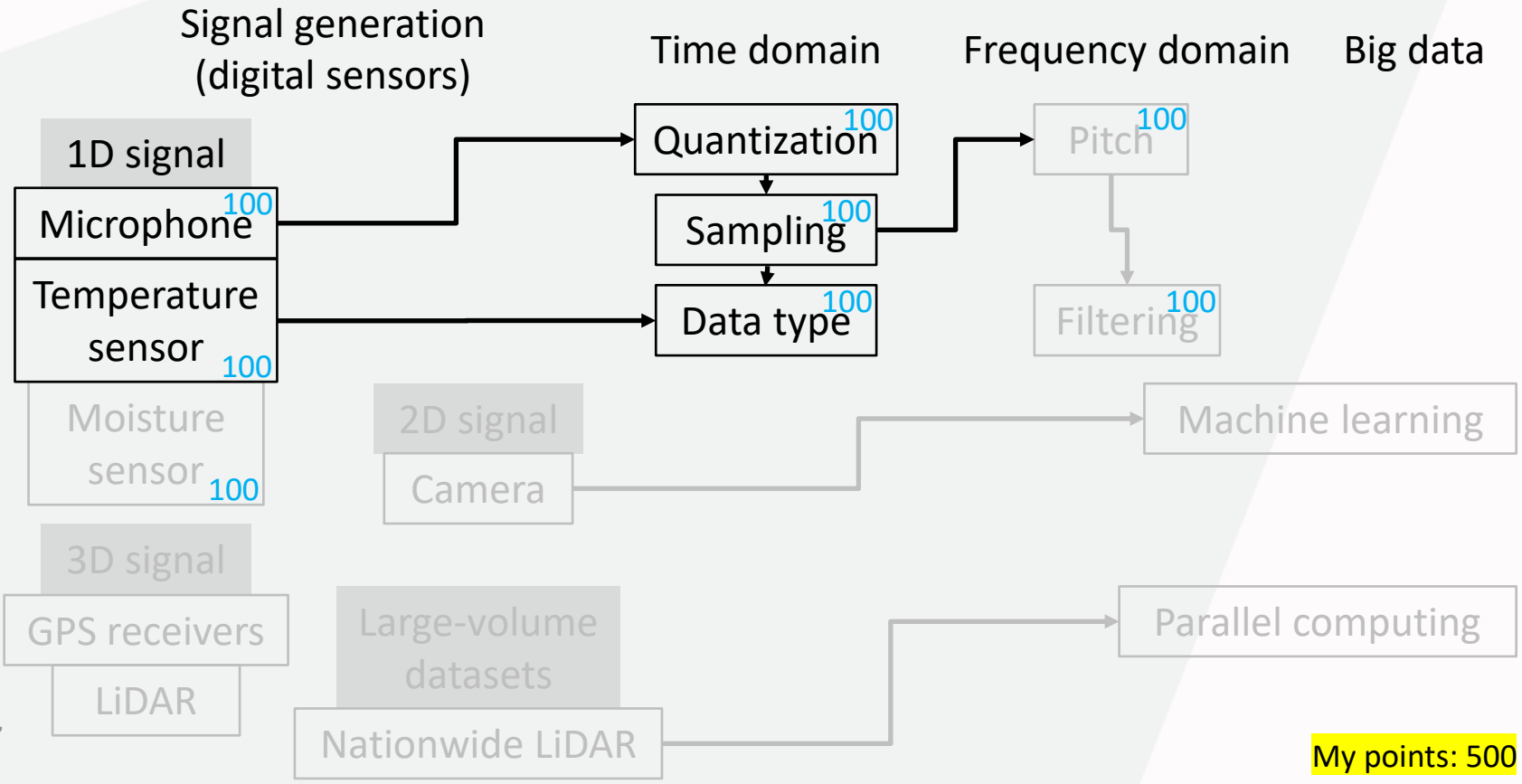
  - Skill tree
  - Point system

Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Point system – Positive feedback to encourage progress



My points: 500

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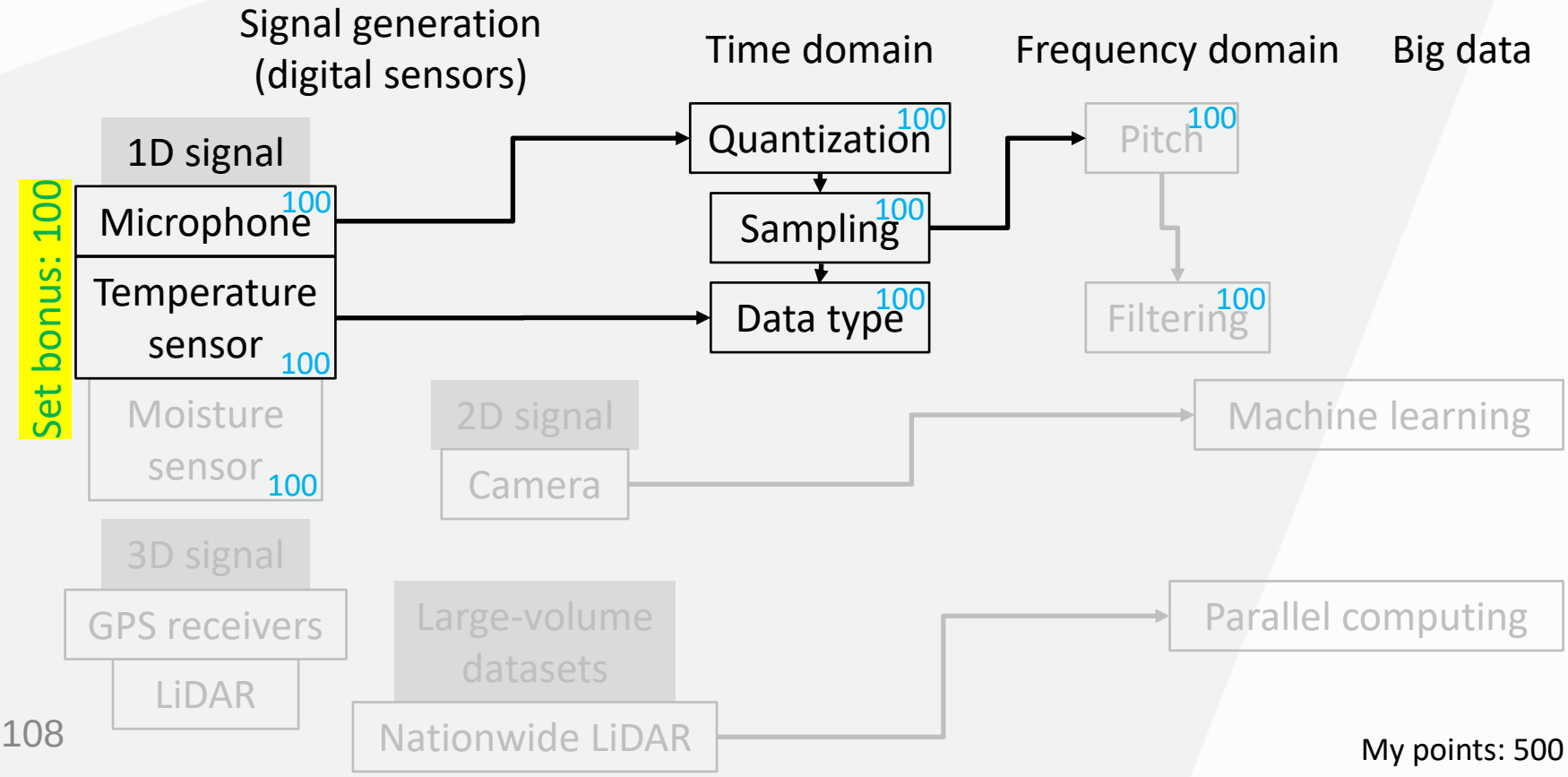

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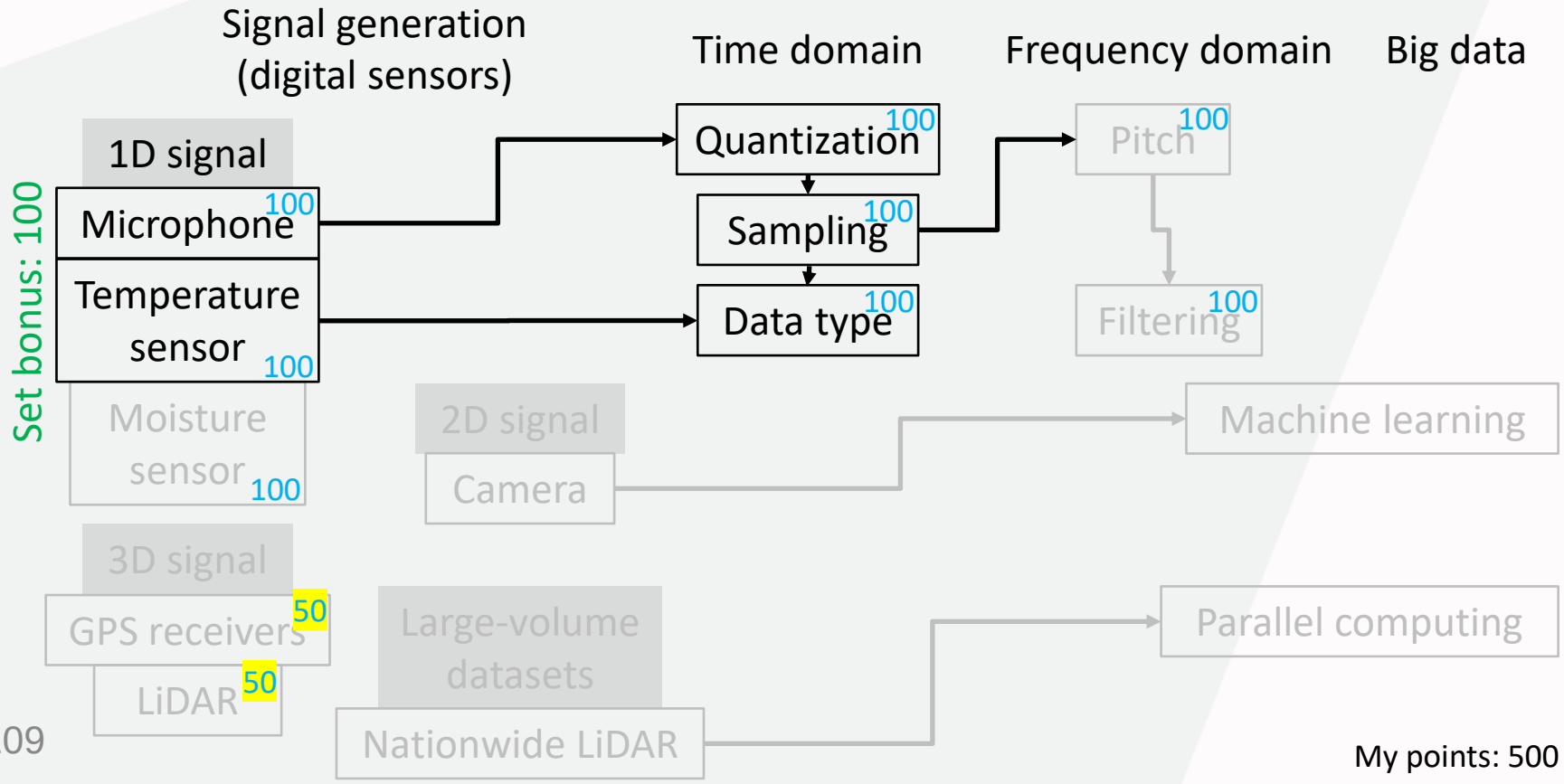

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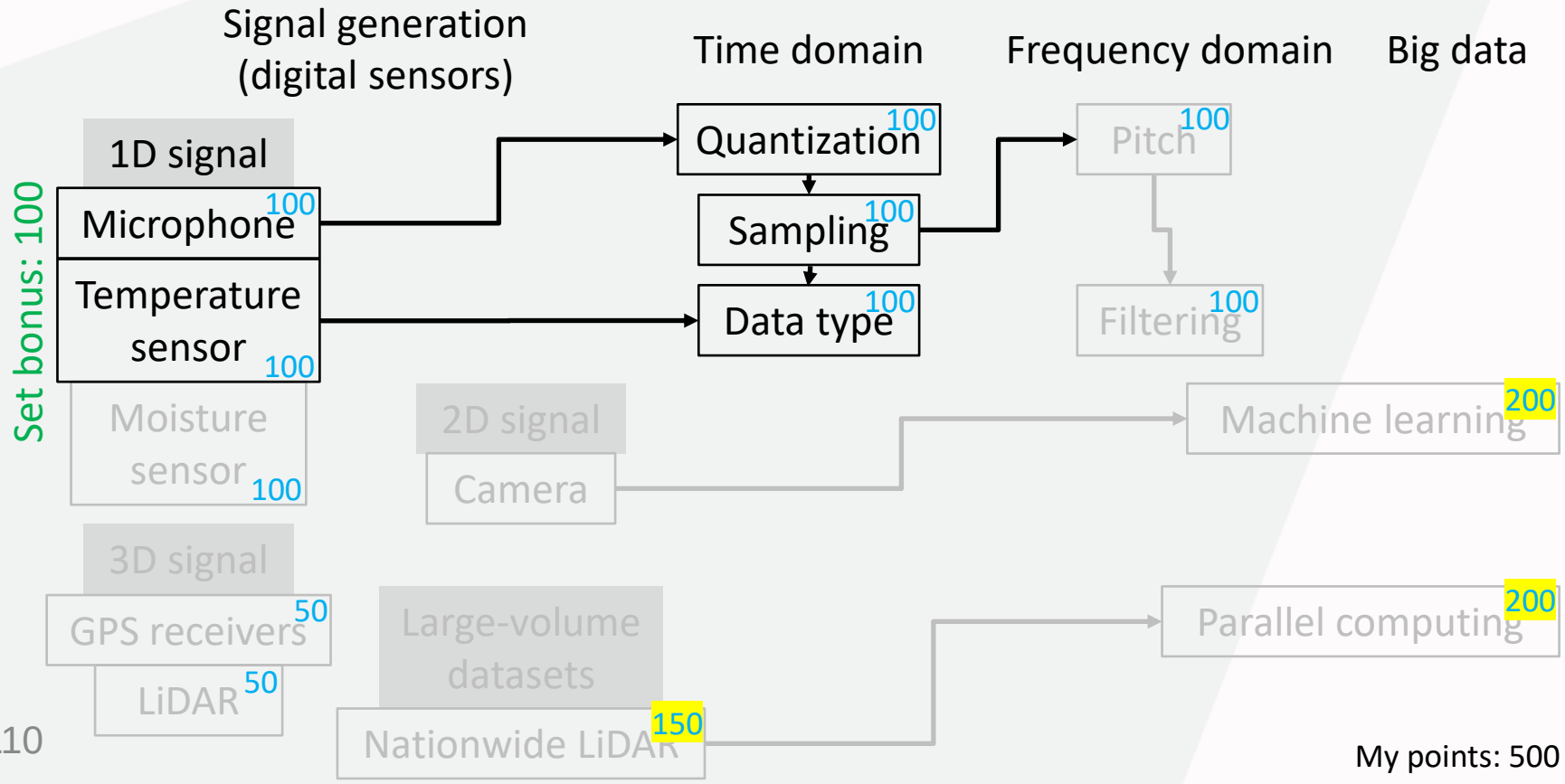

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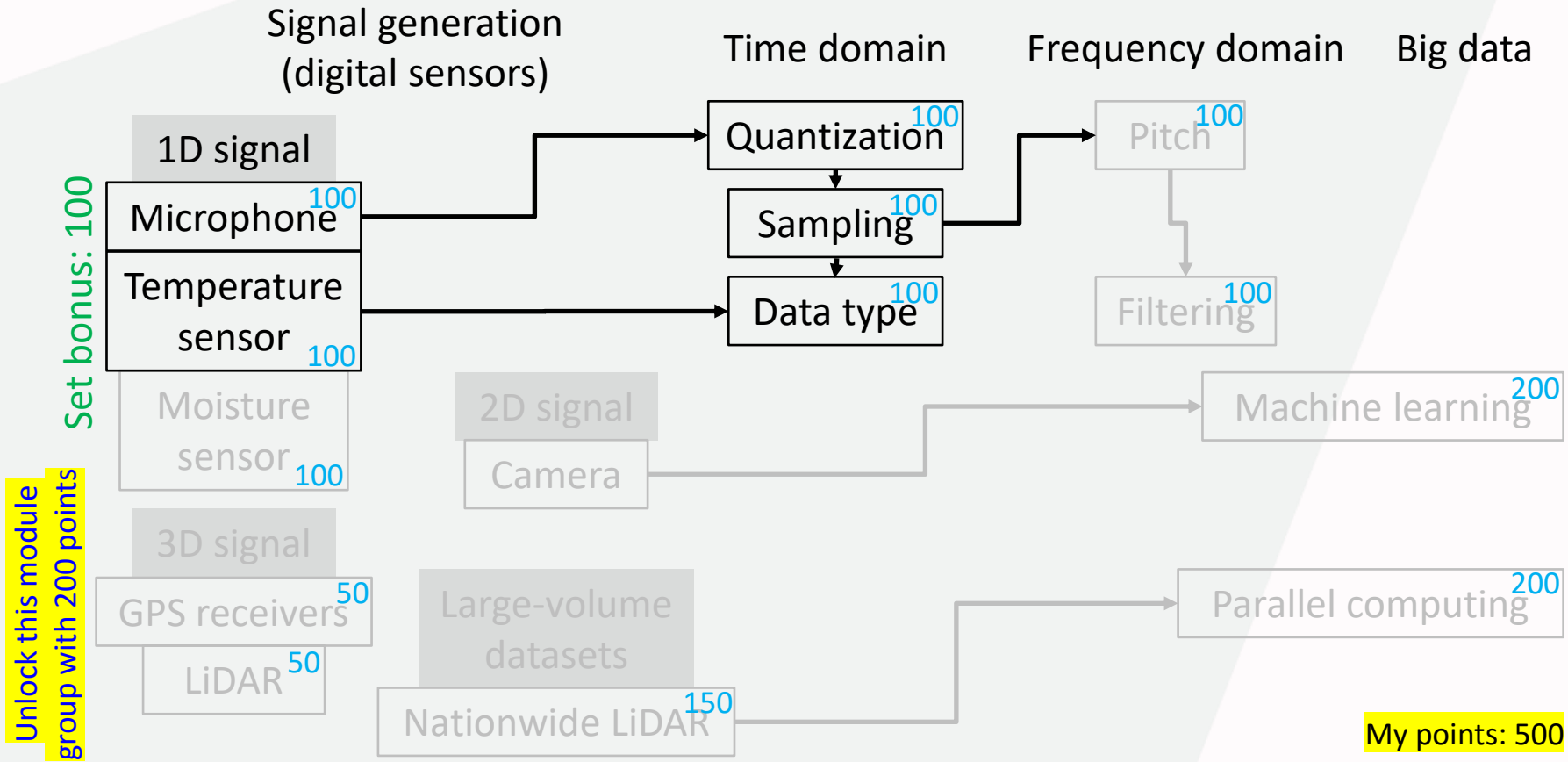

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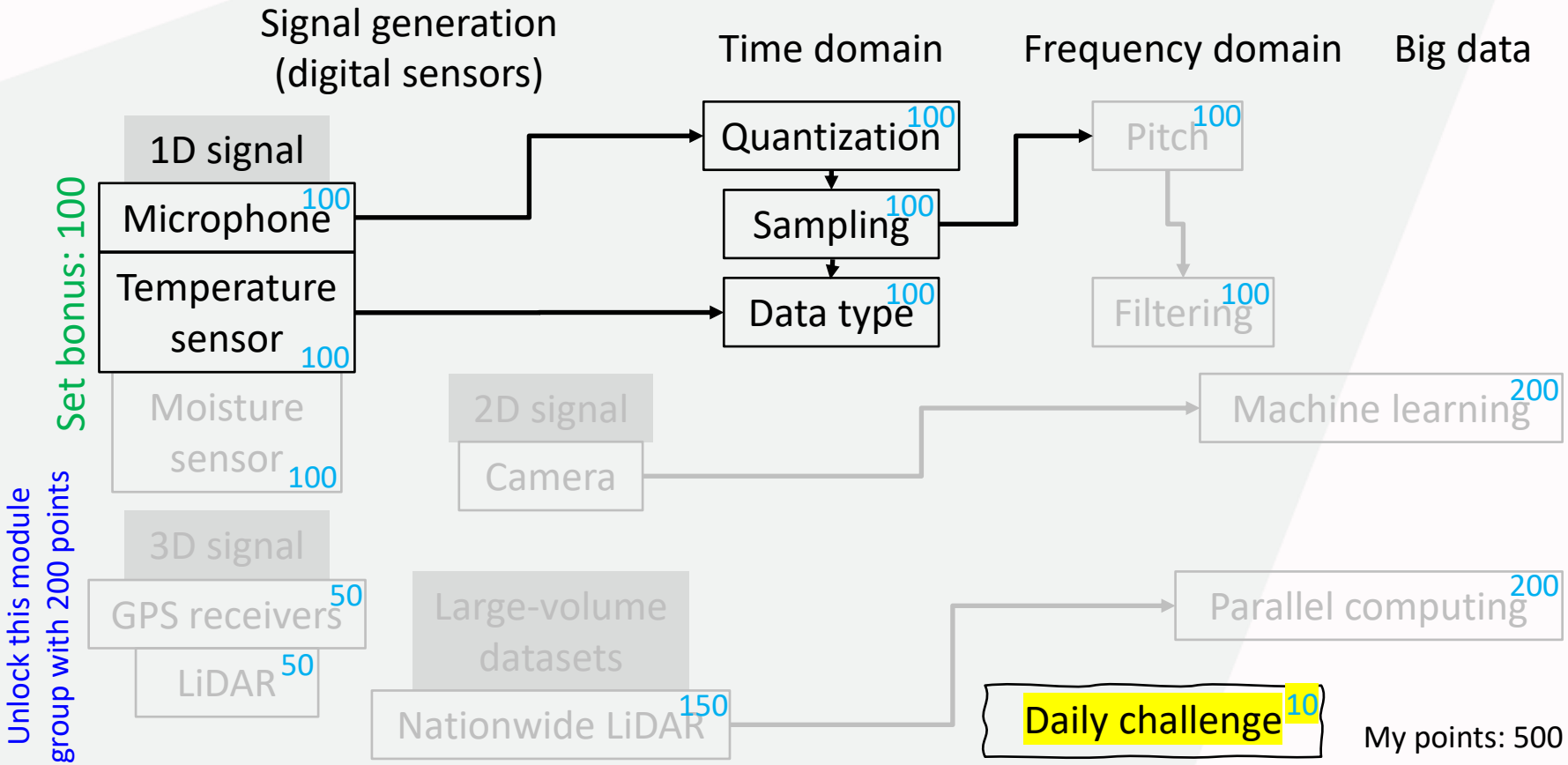

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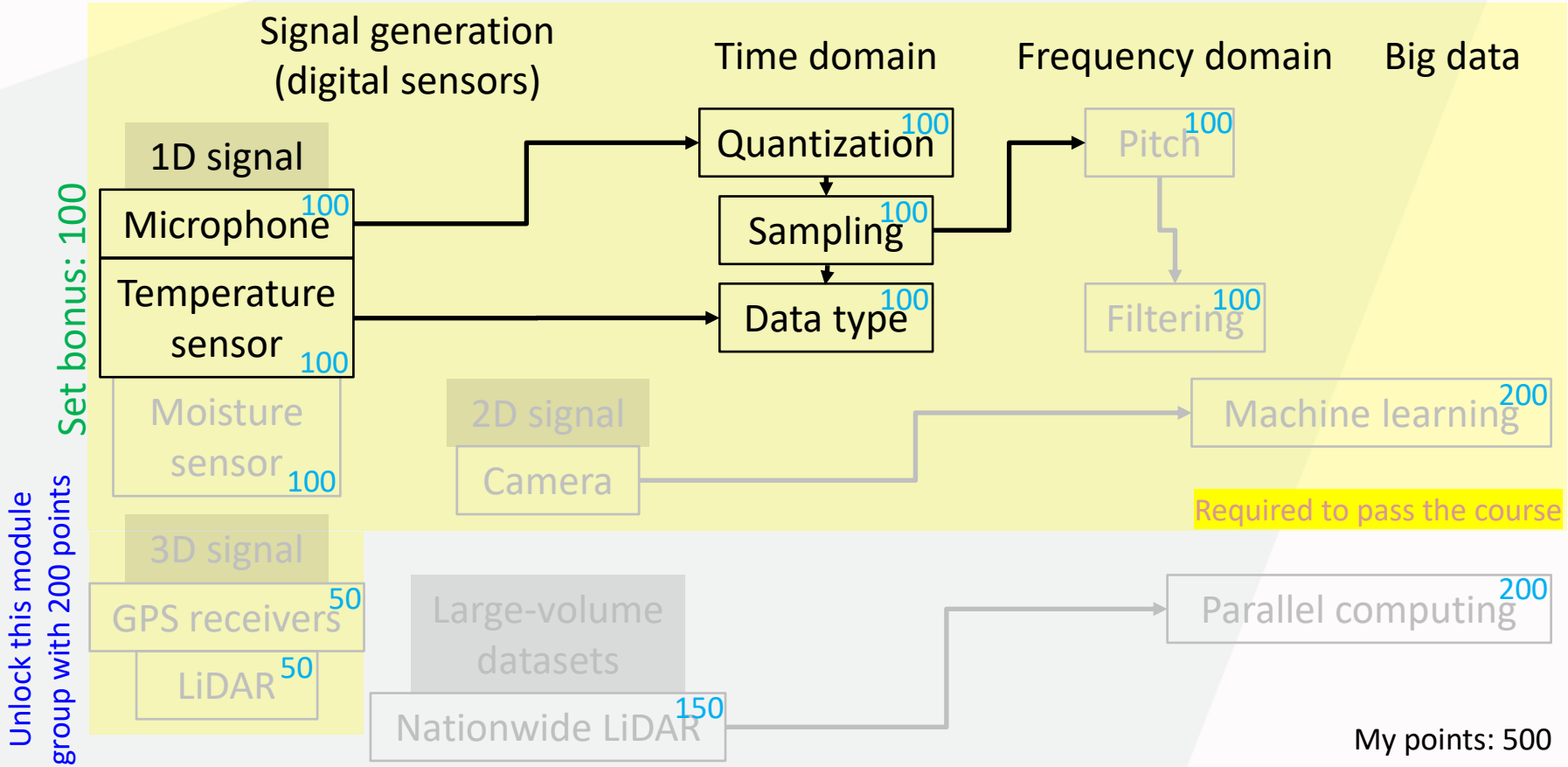

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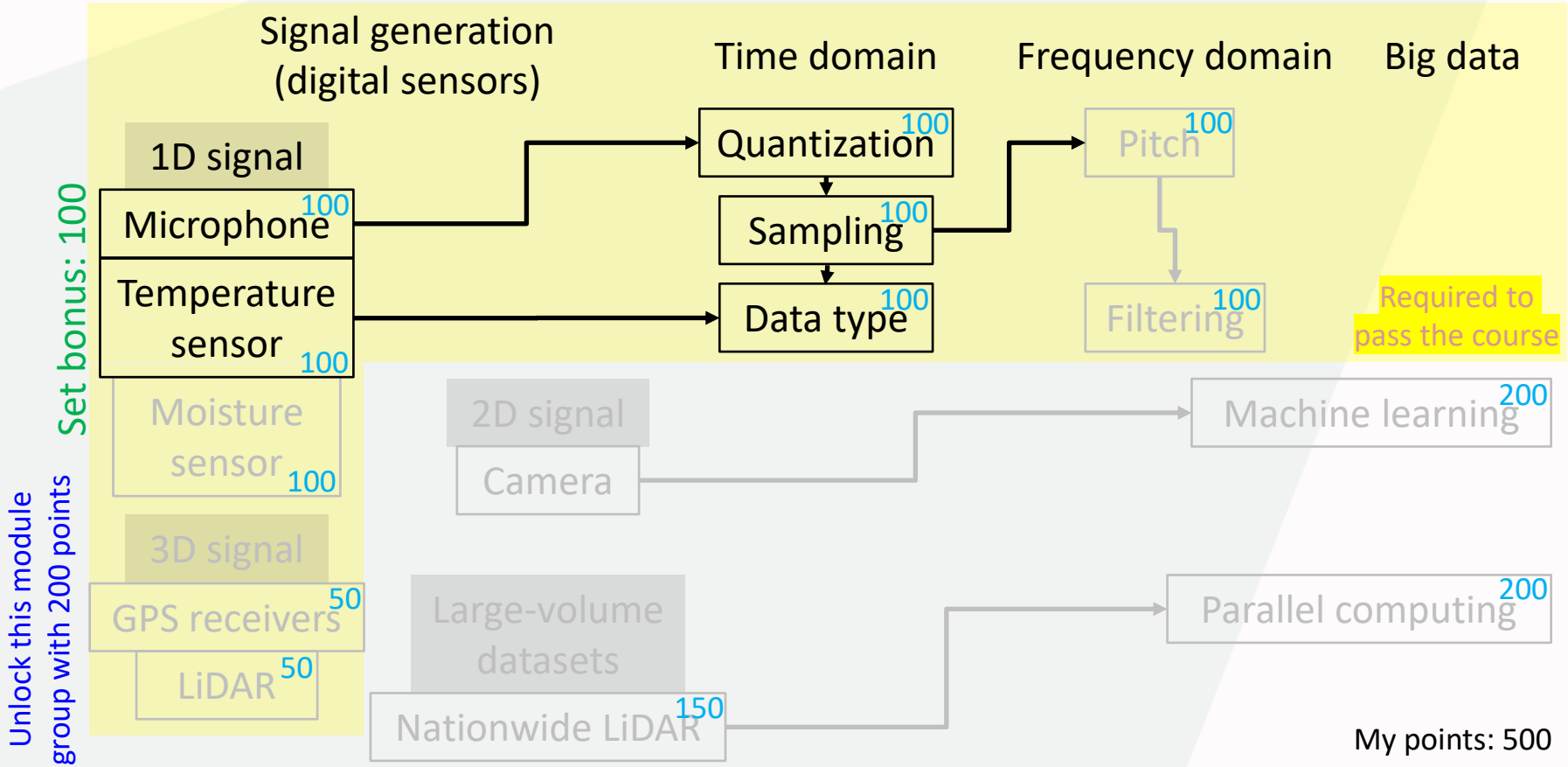

Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Point system – Positive feedback to encourage progress
  - Competition
    - Real-time ranking: most points earned

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  - Hidden challenges
    - Research ideas

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    - Homework hints
    - One-to-one real-time tutoring
  - Hidden challenges and achievements
    - Research ideas and silly jokes

Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Hidden/explicit achievements

Speedrunner! +10 points

Get a specific task done within a limited time.

"Either don't run or… run like crazy!"

Mindreader! +10 points

Get a specific task done without using any hints.

"Hints are not necessary…'cause I'm good at reading your mind!"

A modern game may have hundreds of small achievements for more frequent positive feedback.

Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Assignments – Hide hints by default

Data Science for Agriculture
AGR 333
Lab 4 – Data Collection and IOT

Goal: Understand data collection sources, limitations, and the connection to the internet of thing.

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2. Download and install the latest version for your operating system.
3. Open Arduino to ensure it installed correctly.

Installing ESP Board in Arduino IDE [1]

4. In your Arduino IDE, go to **File> Preferences**
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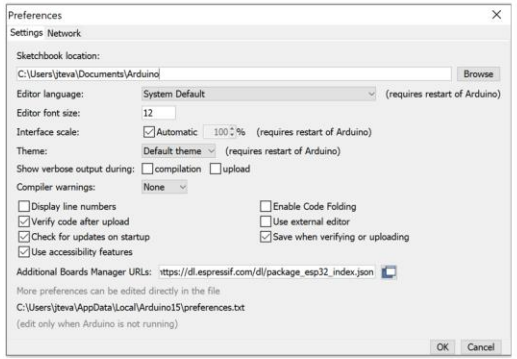

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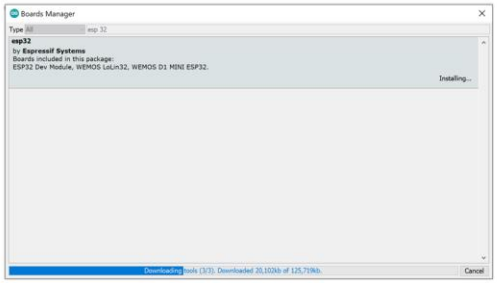

8. If the instillation worked, you should now see ESP 32 boards available in **File>Board**

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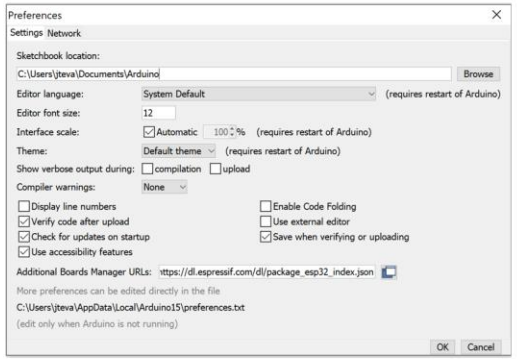

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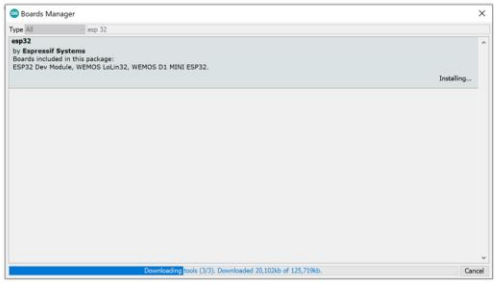

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The ability to follow instructions +
The ability to find solutions and solve problems

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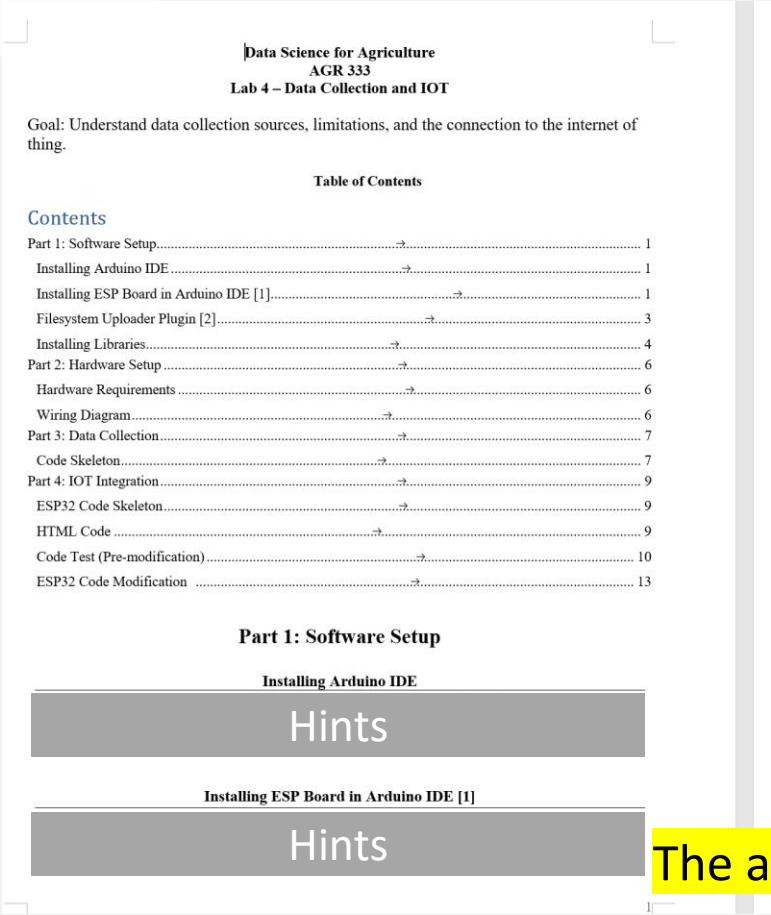

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Hints

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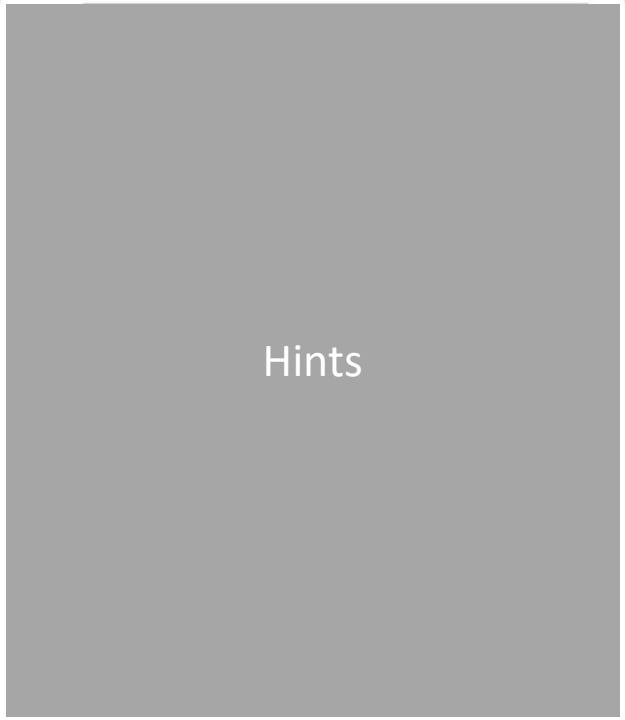
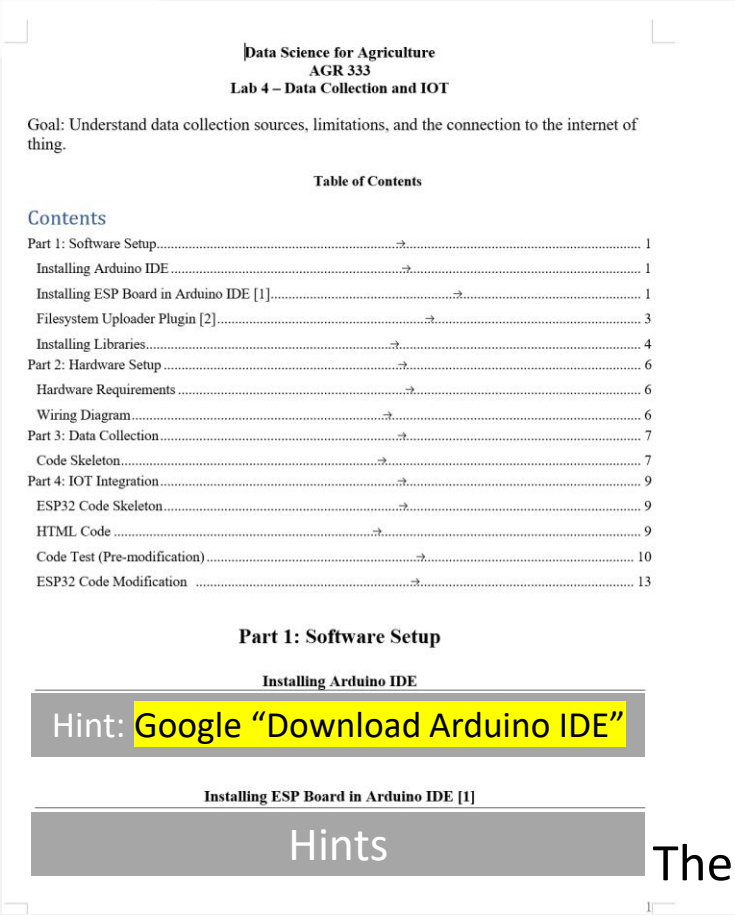
Hints



The ability to follow instructions +
The ability to find solutions and solve problems

Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Assignments – Hide hints by default



Data Science for Agriculture
AGR 333
Lab 4 – Data Collection and IOT

Goal: Understand data collection sources, limitations, and the connection to the internet of thing.

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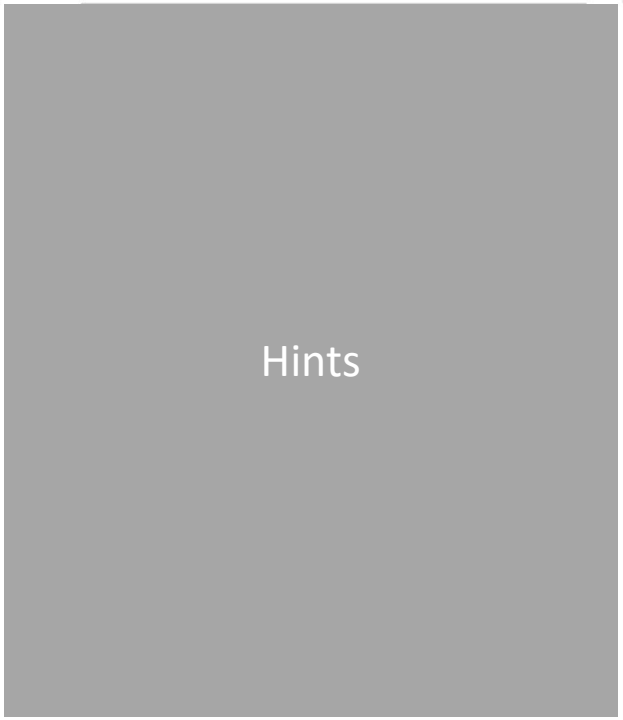
Part 1: Software Setup

Installing Arduino IDE

Hint: Google “Download Arduino IDE”

Installing ESP Board in Arduino IDE [1]

Hints



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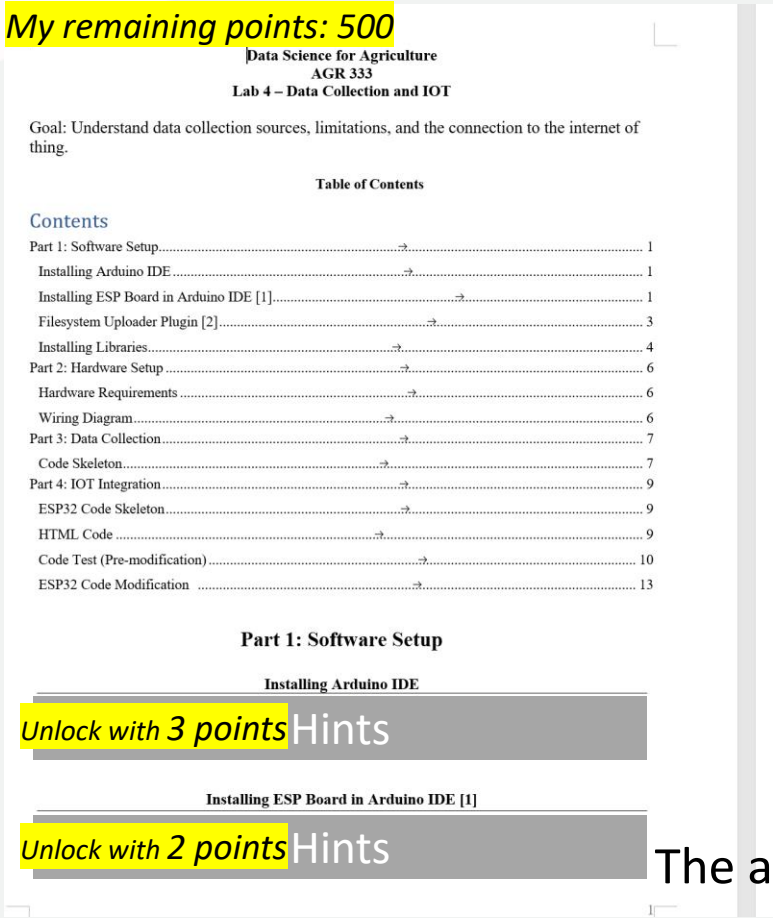

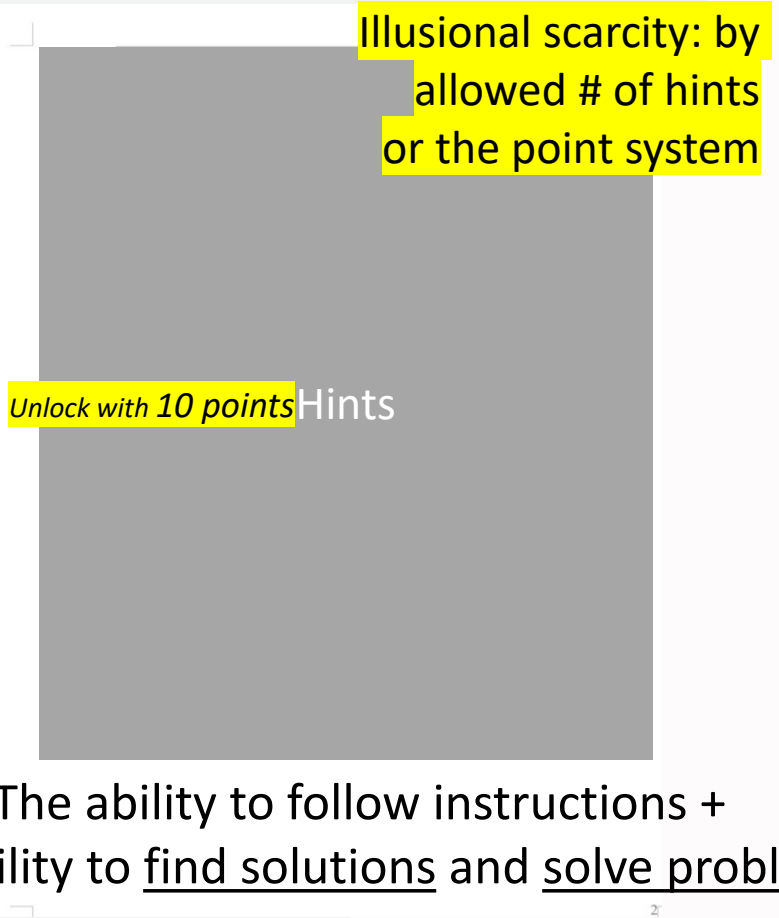

The ability to follow instructions +
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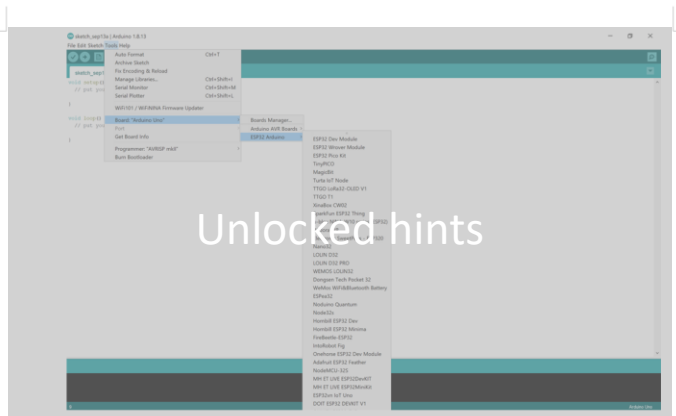
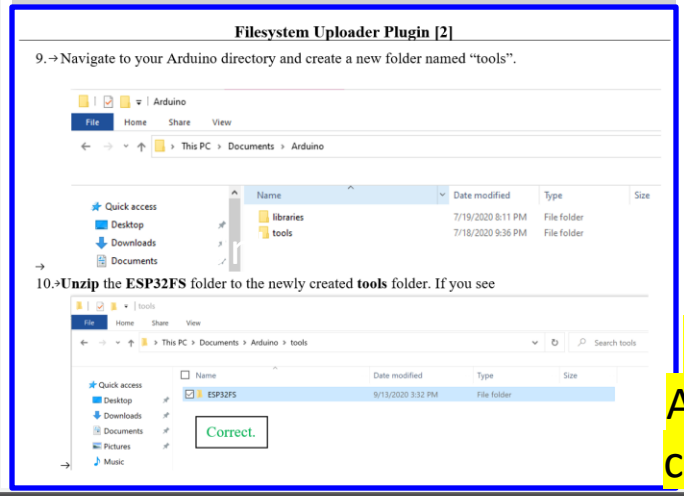
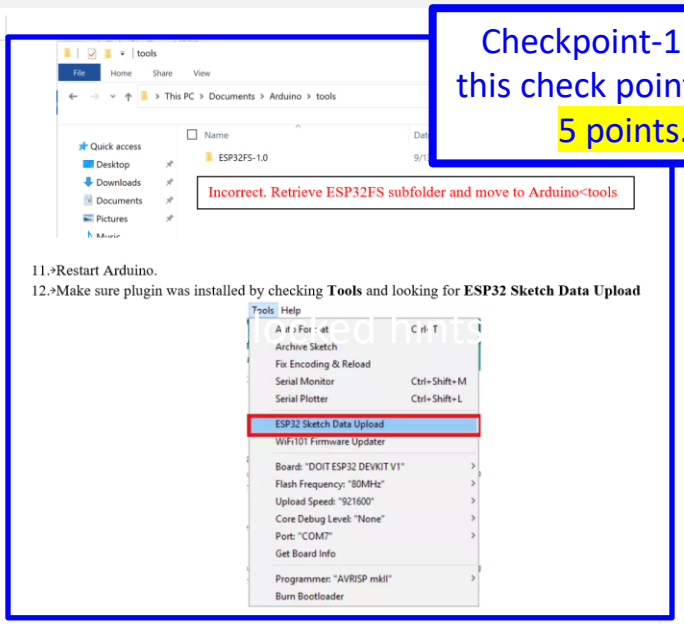
Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Assignments – Automated performance evaluation



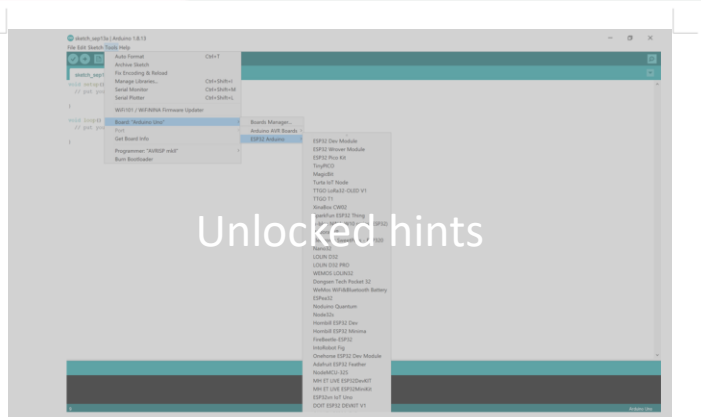


(Partially) Automated check point



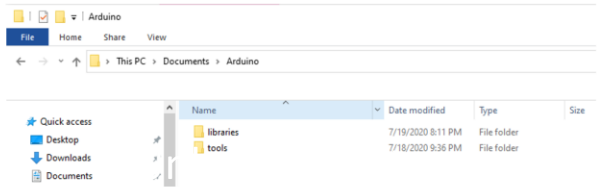
Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Assignments – Automated performance evaluation

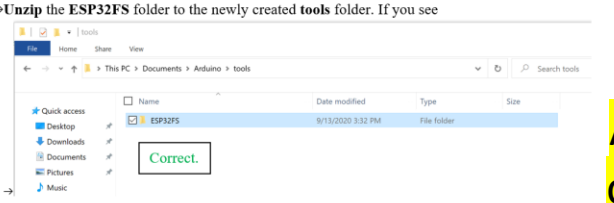


Filesystem Uploader Plugin [2]

9.→Navigate to your Arduino directory and create a new folder named "tools".

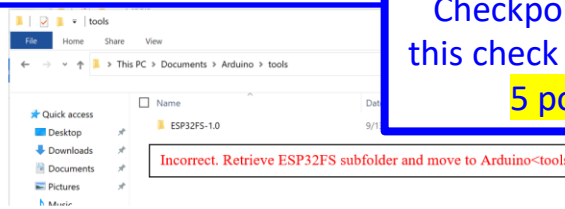


10.→**Unzip** the **ESP32FS** folder to the newly created **tools** folder. If you see



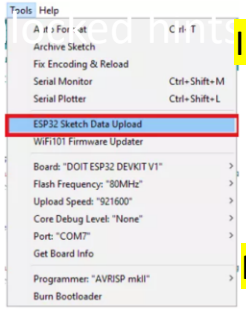
(Partially) Automated check point

Checkpoint-1: Pass this check point to get 5 points.



11.→Restart Arduino.

12.→Make sure plugin was installed by checking **Tools** and looking for **ESP32 Sketch Data Upload**



I confirm things are correct. [ ]

Or

Run this script and copy the output below (more instructions):

Installing Libraries

Unlock with 1 points Hints

Copy the output here

Submit

Tailoring game design techniques for AGR 333 - Data Science for Agriculture

- Rough guidelines
  - The “flow” state
  - Huge amount of content for all levels with progress control and rewards
- Actionable items
  - Expanding content
  - Skill tree
  - Point system

Institute-level support

- Procedures to streamline proposing, testing, promoting better practices
  - Student performance before and after taking different versions of the same the course
- Individual rewards for confirmed better, mimicable practices
- Expert support
  - Professors, game designers, visual artists, programmers, …

Dr. Yaguang Zhang
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PINNACLE OF EXCELLENCE AT SCALE

Thank you!

Tailored game design techniques in this talk

- Motivation:
  - Tell stories/Be personal
  - Take advantage of interesting topics
  - Rewards
- Training approach:
  - Repeated exposures to key ideas
  - Incremental in small steps
  - Visual hints

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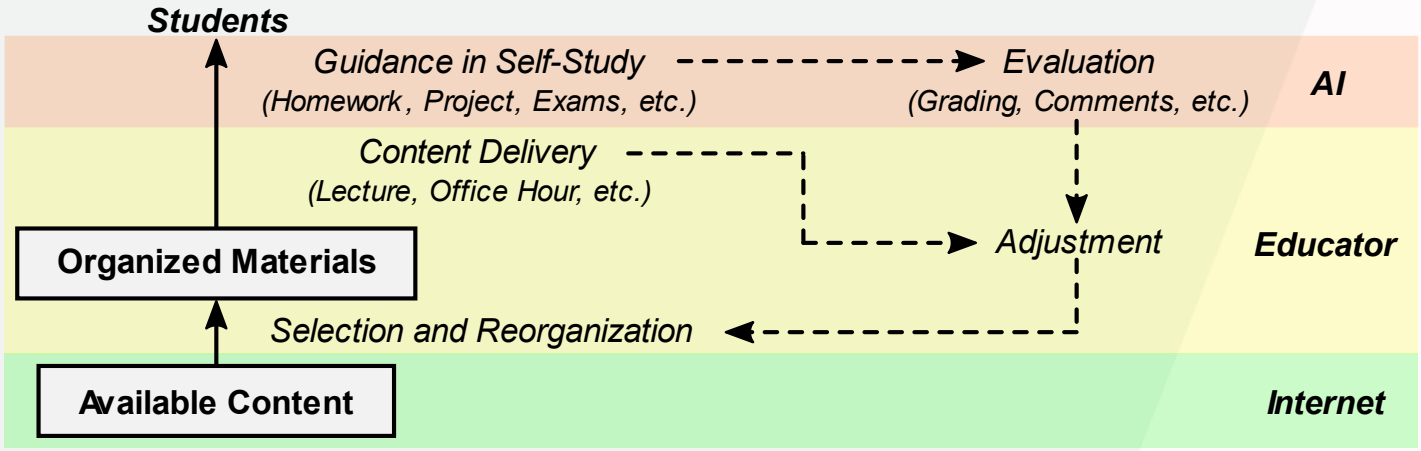
Tailoring game design techniques: Opportunities and challenges

- Reusability
  - Create high-quality content once
- Evaluation automation
  - Ideally with feedback
  - Easier for coding assignments



Selected game design techniques

- Flow (as a rough guideline)
  - Progress control
  - Challenges
- Intuitive visual hints
  - Make the learning experience effortless
  - Reduce effort/cost in fetching study materials

"Let's be do whatever we can to make games fun!"

Not “gamifying”…

More like “sugar coating”

- Provide positive feedback on the side
  - Out of the “learning” process
- Decrease the operations that may hurt the motivation
  - Reduce cost in information fetching

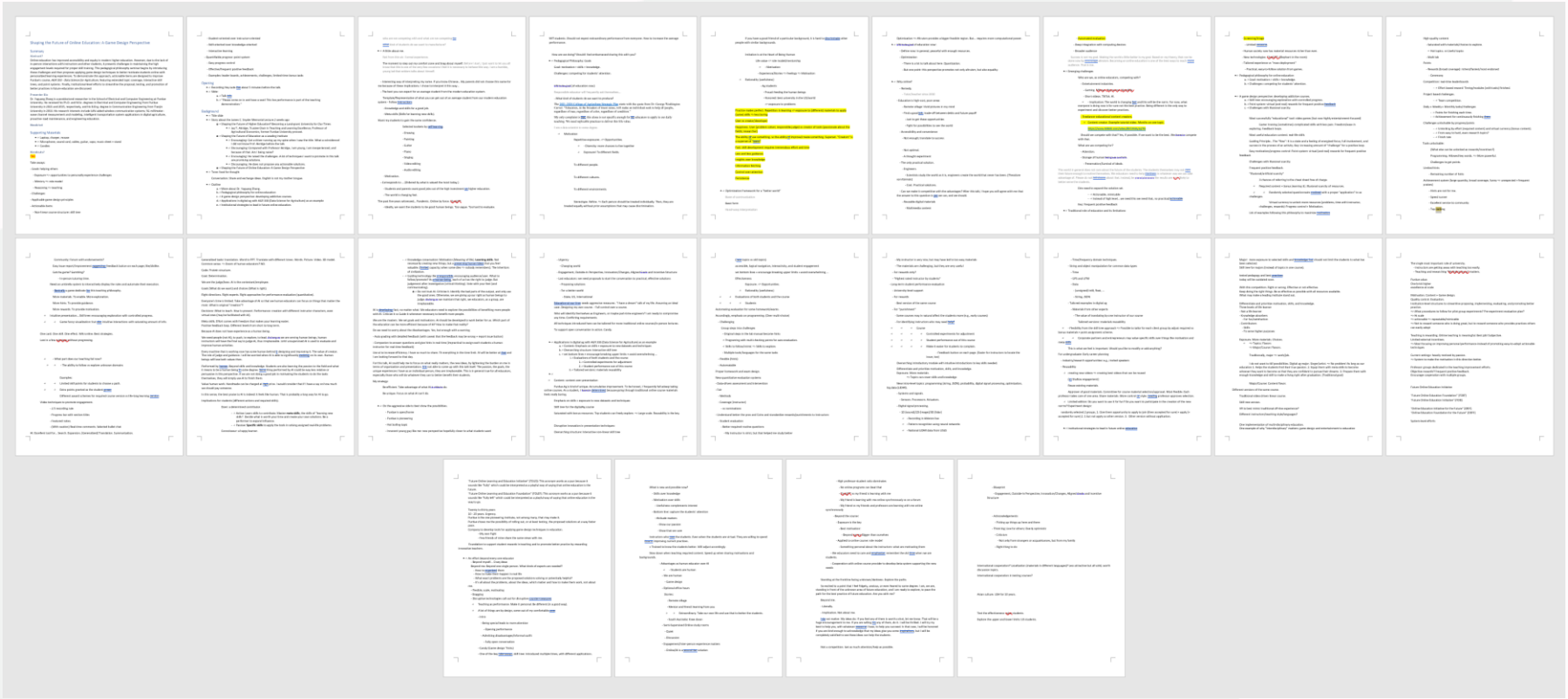
- Example pay-as-you-go program framework
  - For a specific program, we could pre-define a few skills we want to teach. They would serve as module (tree node) groups.
  - Then, we could add relevant online courses into each module group to teach the corresponding skill.
    - Courses can be purchased and studied individually (hence, "pay as you go").
  - The key is that, for each course, we could list alternative versions/flavors of the same course, e.g., with different years, instructors, and/or teaching materials, so that students have the opportunity to customize the program by selecting their preferred versions.
    - We could have one or two free-trial lectures in each course to facilitate the decision.
  - We could also design a course evaluation system for participating students to comment on/rate courses that they finished.

- Benefits of this framework
  - Motivating professors to contribute to online education
    - We could distribute part of the profit from a course to its instructor as an incentive, ideally as a percentage of the profit rather than a fixed base amount.
      - If a star professor becomes rich from their online courses, that will be a great example for us to brag about to persuade other professors to participate.
    - Granting students the option of choosing from different flavors of the same course would promote healthy competition among instructors.
      - Instructors who participate early (e.g., when their courses are essentially the only options) or who can provide higher-quality teaching (e.g., to win the market against multiple competing versions of the same course) will earn the most money.

- A student-oriented course evaluation system
  - The same student performance evaluations (e.g., exams) could be used in the different versions of the same course.
    - Courses with the best student performance => Potential sources for better practices in online education
  - Easy feedback from market/students (Ref: Amazon.com)
    - Most profitable courses, or highly-rated courses with positive comments => Potential versions to promote
- Motivating students to progress in courses
  - We could allow students to buy new courses with points they earn from completed courses.
    - This would increase the "illusional scarcity" of points to better motivate students to progress in purchased courses.
    - We could use other virtual currencies we come up with for this purpose, so that students are still willing to spend points for less valuable resources like hints.
  - The average amount of virtual currency a student can get needs to be carefully planned for the trade-off between student motivation and program profit.

- More flexible payment
  - (Traditional) One-time payment plan
    - Wholesale price for all required courses to get a degree/finish a program should be cheaper than other options, even with the virtual currency considered.
  - (Pay-as-you-go) Buy and take courses one by one
    - A program could enforce an "expiration date" of a course certificate if the student wants to use that for a degree/to complete that program.

22 pages of outline



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