Teaching Self-Paced, Blended, and Mastery-Based Computer Science Classes

BTTVC Presentation by Sarah Strong (she/her)

August 16, 2022

Overview

Who am I?

Why self-paced, blended, and mastery-based?

Why is this model great for teaching computer science?

What do students think of this model?

Pushback and criticism

Who am I?

Figure out Miss Strong!

I have been teaching computer science for N years, where `list(range(N)) == [0, 1, 2, 3, 4]`.

The school board I teach in is the value of `Integer.MAX_VALUE` in Java.

2^{31}: Toronto 2^{31}-1: Waterloo

2^{63}: Peel 2^{63}–1: Halton

My favourite course is the size of this set: `{1, 2, 2, 3, 4, 5, 5}`.

4: ICS2O 5: ICS3U

6: ICS4U 7: TEJ3M

I teach all of the following languages are truthy in Python.

`0`: C `1`: Python `""`: Ruby

`True`: Java `None`: TypeScript

`[0]`: HTML & CSS & JavaScript

True or False: I am in my thirties.

The answer is equivalent to `(5 < 4) || (1 <= 1)`

True or False: I am a Replit certified educator.

The answer is equivalent to `not(1.0 - 1)`

My favourite educational podcast is the colour yellow in hexadecimal.

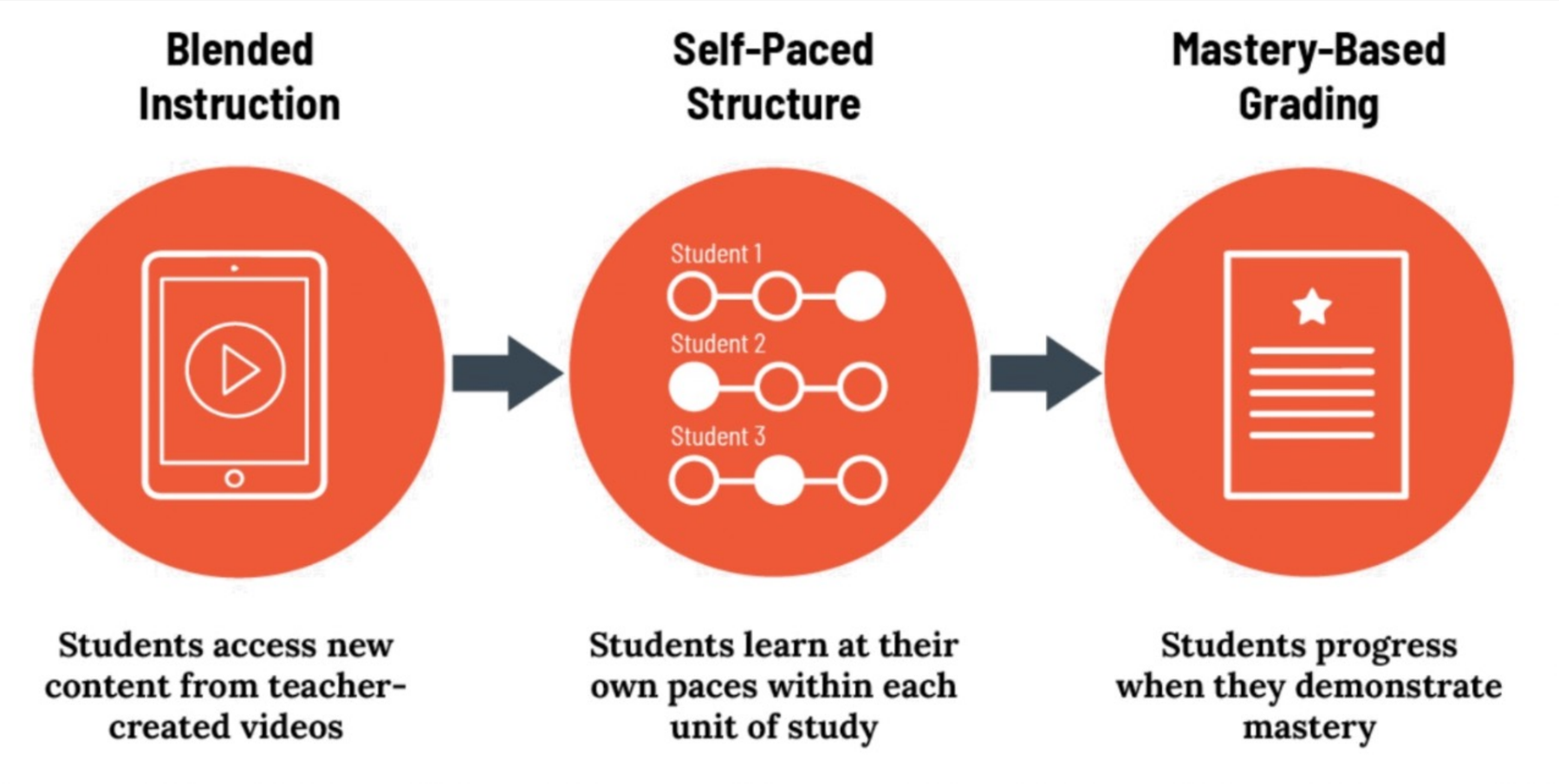
`#00FFFF`: The Cult of Pedagogy

`#FFFF00`: Overthrowing Education

`#FF00FF`: Unprofessional Development

Why self-paced, blended, and mastery-based?

Modern Classrooms Project



Source: http://modernclassrooms.org

Self-Paced Learning

Why self-pace?

- ***Students take different amounts of time to process and learn the same information.***
- ***Students face different barriers in life that affect their ability to learn.***
- ***Self-pacing helps students develop resilience, motivation, confidence, and other important skills.***

Different ways to implement self-pacing

Self-paced can be implemented in many ways:

- *Self-paced lessons*
- *Self-paced weeks*
- *Self-paced units*
- *Self-paced semesters*

How I implement self-pacing

- *There are four units altogether, released one at a time.*
- *Each unit builds on each other. For example, mastery of unit 1 is needed to succeed in unit 2.*
- *Each unit ends with a unit project.*
- *The culminating task is a student conference.*

How I implement self-pacing

- *Students' midterm marks are determined by how far along they get in Unit 1 and 2*
- *Students' final term marks are determined by how far they get along they get in Units 1 to 4*
- *There is an additional Bonus Unit after Unit 4 for students aiming between 98 and 100*

Pacing Trackers

Pacing trackers can be implemented in many ways:

- ***Show the progress through a lesson, unit, or course***
- ***Can show all students or just an individual student***
- ***Can be filled in by the teacher or student***
- ***Can be public or private***

Example (ICS3U)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1		Last Updated: April 15, 8:00 AM																								Green: Complete
2		Unit 1											Unit 2													Yellow: Keep Trying
3	Midterm Mark	35–45				50–62			63–72			73–78	79–81				82–85			86–90		91–94		95–100		Orange: Missing
4	Task	Ethical Computer Use	Post–Secondary Opportunities	Emerging Technologies	Exercise 1.1 – Welcome	Exercise 1.2 – ASCII Cat	Exercise 1.3 – Exact Change	Exercise 1.4 – Leap Year	Exercise 1.5 – Input Checker	Exercise 1.6 – Number Pyramids	Exercise 1.7 – Odd Powers of Three	Project 1 – Solo Game	Binary and Hexadecimal Games	ASCII and Unicode	Computer Components	Environmental Stewardship and Sustainability	Exercise 2.1 – Positive Product	Exercise 2.2 – Round Numbers	Exercise 2.3 – Set of Duplicates	Exercise 2.4 – List Counts	Exercise 2.5 – Unlucky Months	Exercise 2.6 – 1 to 100	Exercise 2.7 – Text Analysis	Project 2 – Human vs Bot	Due: Thursday, April 14 at 9 PM	
5	Location	Google Classroom			Replit							Both	Google Classroom				Replit							Both		
6	blackCow375	C	C	C	C	C	C	C	C	C	C	M	C	C	C	C	KT									
7	blueDog999	C	C	C	C	C	C	C	C	C																
8	cyanTurtle421	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		
9	greenPanda789	C	C	M	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	KT				
10	greyMonkey123	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		
11	indigoCheetah292	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	KT									
12	orangeLion123	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	KT						
13	orangeTurtle123	C	C	C	C	C	C	C	C	C	C	M	C	C	C	C	KT									
14	pinkCat168	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		
15	purplePenguin121	C	C	C	C	C	C	C	C	M	C	C	C	C	C	M	C	KT								
16	sageGreenElephant739	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		
17	turquoiseSnowLeopard724	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C				
18	violetMouse101	C	C	C	C	C	C	C	C																	
19	whiteDuck172	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	KT									
20																										

+ ≡ Final Midterm

Example (ICS2O)

Last Updated: April 15, 8:00 AM

Green: Complete
Yellow: Keep Trying
Orange: Missing

UNIT 1

Unit Mark	35-70								71-100	35-80												81-100
Task	Task 1.1 – Ethical Computer Use	Task 1.2 – Password Protection	Task 1.3 – Phishing	Task 1.4 – Impact of Computers on Health (Part 1)	Task 1.5 – Impact of Computers on Health (Part 2)	Task 1.6 – Social Media Privacy and Data Collection	Task 1.7 – Netiquette and Safety	Task 1.8 – Emailing	Project – Online Safety and Responsibility	Eercise 1.1 – Hello	Eercise 1.2 – Olympic Rings	Eercise 1.3 – Placemat	Eercise 1.4 – Random Circles	Eercise 1.5 – Wobbling Circle	Eercise 1.6 – Meme	Eercise 1.7 – Clock	Eercise 1.8 – Colourful Squares	Eercise 1.9 – Circle Trail	Eercise 1.10 – Snake	Eercise 1.11 – Night and Day	Eercise 1.12 – Dynamic Circle	Project – P5.js Game
Location	Google Classroom									Replit												Both
blackPenguin123	C	C	C	C	C	C	C	C	KT	C	C	C	C	C	C	C	C	C	C	C	C	C
blueBird374	C	C	C	C	C	C	C	C	C	C	M	C										
blueCrocodile682	C	C	C	C	M	M	M	C		C	C	C	C	C	C							
blueDog666	C	C	KT							C	C	C	C									
blueLion221	C	C	C	C	C	C	C	C		C	C	C	C									
bluePanda344	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
blueTiger386	C	KT								C	C	C	C	C	C	C	C	C	C	C	KT	
blueRaccoon999	KT	KT								C	C	C	C	C	C	C	C	C				
greenLion435	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
greenPanda176	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
greenPlatypus489	C	C	C	C	C					C	C	C	C	C	C	C	C	C	C	C	C	
greyGoose316	C	C	C	C	C	C	C	C		C	C	C	C	C	C	C	C	C	C	C	C	
greyRat888	C	C								C	C											
lavenderCat002	C	C	C	C	C	C	C	C		C	C	C	C	C	C	C	C	C	C	C	C	
purplePanda246	C	C	C	C	C	C	C	C		C	C	C	C	C								
purpleRat123	C	C								C	KT	KT	KT									
redCat123	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
redDog101	C	C								C	C	KT	KT									

UNIT 2

Unit Mark	35-70								71-100	35-80												81-100	Due date: Thursday, April 14 at 2:05 PM
Task	Task 2.1 – Browsers and Search Engines	Task 2.2 – Keyboard Shortcuts	Task 2.3 – Operating Systems	Task 2.4 – Hacking	Task 2.5 – Onling Researching	Task 2.6 – Find and Replace	Task 2.7 – File and Folder Organization	Task 2.8 – Email Organization	Project – Power User	Eercise 2.1 – Flashcards	Eercise 2.2 – Checkerboard	Eercise 2.3 – Grid Colouring	Eercise 2.4 – Monochrome Circles	Eercise 2.5 – Shooting Stars	Eercise 2.6 – RGB Manipulation	Eercise 2.7 – Colour Palette	Eercise 2.8 – Overlapping Circles	Eercise 2.9 – Three in One	Project – P5.js Screensaver				
Location	Google Classroom									Replit									Both				
blackPenguin123	C	C	C	C	C	C				C	C	C	C	C	C	C	C	C	C				
blueBird374	C	C	C	C	C	C	C	C		C	C	C	C	M	C	C	C						
blueCrocodile682	C																						
blueDog666	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C				
blueLion221	C	C	C	C	C	C				C	C	C	C	C	C	C	C	C	C				
bluePanda344																							
blueTiger386	C	C	C	C	C	KT	C	C	C	C													
blueRaccoon999	C	C	C	C	C	C	C	C		C	C	C	C	C	C	C	C	C	C				
greenLion435	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C				
greenPanda176										C	C	C	C	M	C	M	C						
greenPlatypus489	KT	KT	KT	KT						M	M	M	C										
greyGoose316																							
greyRat888	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C				
lavenderCat002	C	C	C	C	C	C	C	C		KT													
purplePanda246	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C				
purpleRat123	C	C	C	C	C	C	C	C		KT													
redCat123	M	C	M	M	M	M	M	M	C	C	C	C	C	C	C	C	C	C	C				
redDog101	C																						

All Units | Midterm Info | Final Info

What questions do you have so far?

Blended Learning

Why blended learning?

In order to implement self-pacing effectively, live lectures must be removed.

Live lectures can be replaced with video lessons and small group instruction.

Making videos

There are plenty of options for videos:

- *Screencast videos*
- *Recordings of lectures*
- *Recordings of document camera presentations*

Why videos?

Lots of reasons!

- ***Students who are absent have a fair shot at catching up***
- ***Students who get help at home can share the videos with their helpers***

Why videos?

- *Students can rewind, rewatch, pause, speed up/down, turn on subtitles etc.*
- *Videos are straight to the point whereas lectures tend to be long and have tangents and disruptions*
- *It frees up my time so I can spend more time helping students.*

Why videos?

- *Students who have poor vision or hearing can see/hear videos clearer than lectures.*
- *Students who have trouble focusing during live lectures (e.g. students with ADHD) don't have to endure them.*
- *Multi-language learners can turn on auto-translated subtitles*

Why videos?

- *In case of unexpected distance learning days, there are very few changes to the plan*
- *It makes it easy for substitute/supply teachers*

Making effective videos

Tips for making videos:

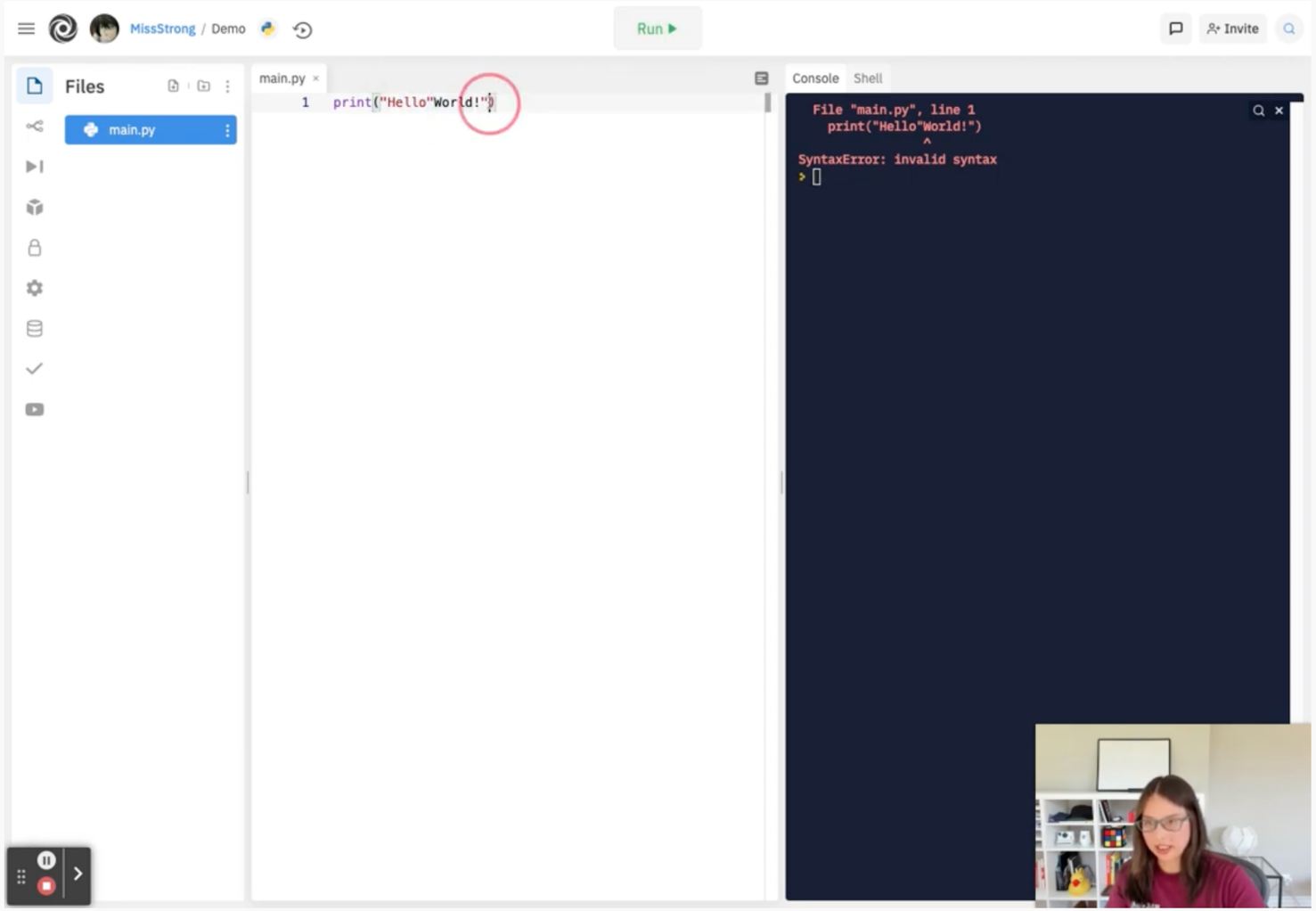
- ***Keep videos shorter than 6 minutes***
- ***Speak at a fast pace using conversational language***
- ***Don’t over-edit – mistakes improve engagement***

Making effective videos

Tips for making videos:

- ***Make videos reusable – don't mention lesson numbers and other things that might change during the video***
- ***Upload videos to YouTube so that students can turn on auto-generated subtitles***

Example



String Operators and Special Characters (Unit 1, Lesson 2.1)

Unlisted

Grade 11 Computer Science with Python (Unit 1)

Unlisted Miss Strong - 7 / 36

2 **Introduction to Replit (Unit 1, Lesson 1.1)** 4:47 Miss Strong

3 **Hello World (Unit 1, Lesson 1.2)** 4:57 Miss Strong

4 **User Input (Unit 1, Lesson 1.3)** 3:55 Miss Strong

5 **Naming Conventions (Unit 1, Lesson 1.4)** 2:56 Miss Strong

6 **String Concatenation (Unit 1, Lesson 1.5)** 1:58 Miss Strong

▶ **String Operators and Special Characters (Unit 1, Lesson 2.1)** 4:51 Miss Strong

Example

main ICS3U / Unit 1 / 2.1 String Operators and Special Characters.md Go to file ···

MissStrong Update 2.1 String Operators and Special Characters.md Latest commit cd21dbe on Sep 7, 2021 History

1 contributor

34 lines (23 sloc) | 1.09 KB Raw Blame

Link to video.

String Operators

We've seen that the `+` operator can be used for string concatenation.

The lines below print `"butterfly"`.

```
print("butterfly")  # prints "butterfly"
print("butter" + " fly")  # also prints "butterfly"
```

We can also use the `*` operator for **string multiplication**.

The line below prints `"hahaha"`.

```
print("ha" * 3)  # prints "hahaha"
```

Special Characters

In order to put any of the following special characters in a string, you need to put the **escape character** `\` (backslash) in fro

Example

Unit 1

TITLE	DUE DATE	SUBMISSIONS	PUBLISHED
Exercise 1.1 – Welcome	–	View submissions 32 of 31 started 29 of 31 submitted	
Exercise 1.2 – ASCII Cat	–	View submissions 29 of 31 started 29 of 31 submitted	
Exercise 1.3 – Exact Change	–	View submissions 29 of 31 started 29 of 31 submitted	
Exercise 1.4 – Leap Year	–	View submissions 29 of 31 started 29 of 31 submitted	
Exercise 1.5 – Input Checker	–	View submissions 29 of 31 started 29 of 31 submitted	
Exercise 1.6 – Number Pyramids	–	View submissions 29 of 31 started 29 of 31 submitted	
Exercise 1.7 – Odd Powers of Three	–	View submissions 28 of 31 started 27 of 31 submitted	
Project 1 – Solo Game	–	View submissions 29 of 31 started 27 of 31 submitted	

What questions do you have so far?

Mastery-Based Learning

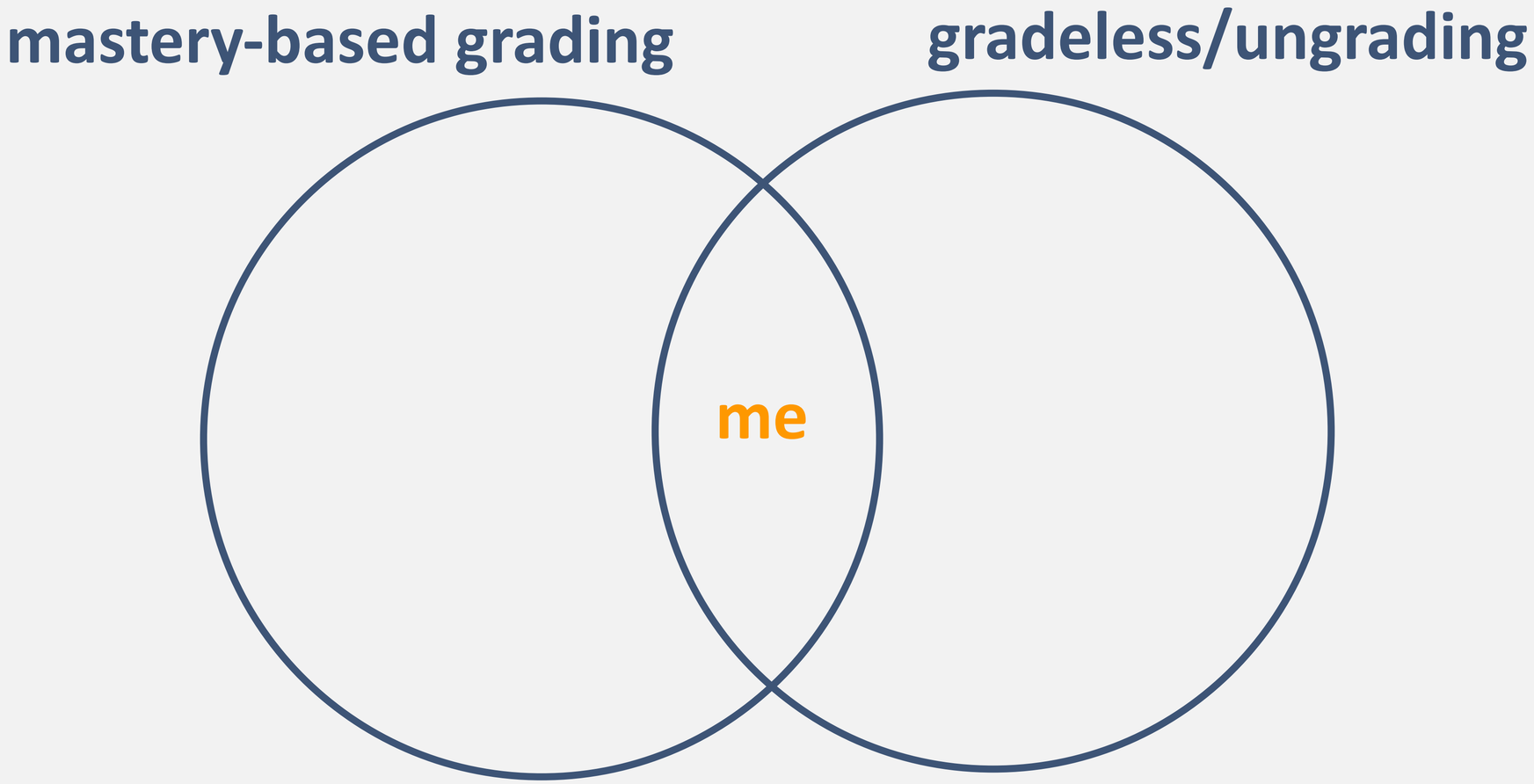
Mastery-Based Grading

Mastery-based grading means students are given a mastery status instead of a percentage or level. Students don't move onto new material until they have demonstrated mastery of the pre-requisite material.

Demonstrating mastery is crucial for:

- *Retention*
- *Building confidence*
- *Focusing on learning, not grades*

Mastery versus gradeless/ungrading



How I implement mastery-based grading

All exercises on Replit are either:

- *not started*
- *in progress*
- *complete (mastered)*

Students move on to the next task when they have completed the previous ones.

How I implement mastery-based grading

All exercises on Replit have criteria for mastery, such as:

- *passing all the I/O or unit tests*
- *including relevant and helpful line comments*
- *following conventions*
- *including custom tests*
- *declaring their sources*

Example

ICS3U02BCI2022 / Exercise 1.2 – ASCII C...

Run

Files

main.py

sources.md

main.py

```
print(".         .")
print(" \\'-\"'\"-'/ ")
print("  } 6 6 { ")
print("  =. Y .= ")
print("   /^^^\ . ")
print("  /     \ ) ")
print("  ( )-( )/ ")
print("   \"\" \"\"  ")
```

CPU RAM Storage

Console Shell Instructions

Before Starting This Task

It's recommended that you only begin this task if you have already submitted Exercise 1.1. It's okay if you are waiting for it to be marked.

Choose between watching all the videos or reading all of the notes.

- String Operators and Special Characters (video|note)
- Multi-Line Strings (video|note)
- The Console (video|note)

Requirements to Pass

1. Get all input/output tests to pass.
2. Answer the questions in **sources.md**.
3. Click Submit in the top-right corner.

If you submit this task without meeting these criteria, you will be asked to redo it and resubmit it.

Instructions

Create a program that prints the following cat.

```
.         .
 \'-"'"-'/
  } 6 6 {
  =. Y .=
   /^^^\ .
  /     \ )
  ( )-( )/
   "" ""
```

Do not use raw strings (e.g. `r" \ "`). You must use at least one escape

Example

ICS3U02BCI2022 / Exercise 1.2 – ASCII C...

Run

Files

main.py

sources.md

sources.md

Preview

Console Shell Instructions Markdown

```
## Sources

### Reminders

* In this course, getting help from online sources is okay as long as you cite them and indicate which lines of code you copied.
* In this course, getting help from other people is okay as long as you are not copy/pasting their code and you are doing all the typing.
* It is considered cheating if you copy code from your peers or get someone to do all the work for you.
* Each project file has a file history that can be used to easily determine excessive copy/pasting.
* Lying about your sources (e.g. saying you didn't get help when you actually did) can lead to disciplinary actions.

### Answer the questions below before submitting this task.

1. Did you use any online sources aside from the assigned videos and notes? (Yes/No)

→No

1a. If you answered 'Yes' to Question 1, put the links to any online sources you used.

→

1b. If you answered 'Yes' to Question 1, indicate which lines of code you copy/pasted.

→

2. Did you have any help from anyone aside from the teacher? (Yes/No)

→

2a. If you answered 'Yes' to Question 2, indicate who helped you (e.g. a classmate, a relative, a tutor, etc.).

→

2b. If you answered 'Yes' to Question 2, indicate how each person helped
```

Preview of sources.md

Sources

Reminders

- In this course, getting help from online sources is okay as long as you cite them and indicate which lines of code you copied.
- In this course, getting help from other people is okay as long as you are not copy/pasting their code and you are doing all the typing.
- It is considered cheating if you copy code from your peers or get someone to do all the work for you.
- Each project file has a file history that can be used to easily determine excessive copy/pasting.
- Lying about your sources (e.g. saying you didn't get help when you actually did) can lead to disciplinary actions.

Answer the questions below before submitting this task.

1. Did you use any online sources aside from the assigned videos and notes? (Yes/No)

→No

1a. If you answered 'Yes' to Question 1, put the links to any online sources you used.

→

1b. If you answered 'Yes' to Question 1, indicate which lines of code you copy/pasted.

→

2. Did you have any help from anyone aside from the teacher? (Yes/No)

→

CPU RAM Storage

What questions do you have so far?

What do students think?

What did you most enjoy about this course?

- It's very relaxing and stress is kept at a low
- Meeting new people in this class who I have not met before
- Being able to socialize and work with the people around me
- Not having quizzes and tests
- Miss Strong is always there to help
- The fact that you can do the work whenever you want
- Making games and playing games
- The final projects at the end of each unit

What did you least enjoy about this course?

- **Too much freedom… it took me a while to get used to it**
- **Everyone is loud**
- **Coding is hard**
- **The videos were nice but I would have preferred live lessons**
- **Sometimes I finished my work too early and got bored**
- **Sometimes the notes had typos and I got confused**

Pushback and Criticism

Common criticism from admin, educators, and parents

- **This isn't real teaching**
- **Students didn't sign up for online learning**
- **There's too much screen time**
- **Students are not developmentally ready for self-pacing**
- **Won't students just skip class?**
- **Mastery grading causes mark inflation**

As educators our goal should be to be independence facilitators.

Kelly Rogers, Psy.S., BCBA

What questions do you have left?