

UCF RET Site: Research Experiences in Computer Vision and Machine Learning Lesson Plan

0200335: AP Computer Science Principles

2018

MIRTES CORREA

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RET Site: Research Experiences in Computer Vision and Machine Learning Lesson Plan

Course: AP Computer Science Principles
Grade Level: 9th – 12th Grade

Part A - COMPUTER VISION

Suggested Length of Lesson: 1 Day

Materials/Technology Needed
- Lap top
- Power point
- NEARPOD.COM
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Where this Fits
- Students learn about what is Computer Vision and where you can apply it.

Lesson Objective(s)/Learning Goal(s)
- Students will be able to understand what is Computer Vision.
- Students will be able to identify areas that are using computer vision
- Students will be able to explain why computer vision is giving a better approach and precision, including saving time and money

Standard(s)/Benchmark(s) Addressed
- *SC.912.CS-CS.2.13 Explain how automated software testing can reduce the cost of the testing effort.*
- *SC.912.CS-CS.2.14 Explain what tools are applied to provide automated testing environments.*
- *SC.912.CS-CS.3.1 Describe digital tools or resources to use for a real-world task based on their efficiency and effectiveness.*

Standards for Mathematical Practice
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others
- Model with mathematics
- Look for and express regularity in repeated reasoning

Instructional Strategies
- *Monitoring Progress*
  - Reflection/Response class questioning and written reflections
- *Compare and Contrast*
  - Different machine learning algorithms
- *Graphing Organizers*
  - Charts and diagrams explaining algorithms

Evidence of Learning (Assessment Plan)
- Students will learn about Computer Vision
- Students will be exposed to different areas of application

Description of Lesson Activity/Experiences

1. *Go through attached presentation*
2. *Show students what is Computer Vision and areas of application (NEARPOD)*
3. *Show the class UCF involvement with the Computer Science / Computer Vision program*
4. *Class activity (NEARPOD) and discussion*
   a. In your own opinion, Why computer vision is important?
   b. Cite 3 areas that computer vision is most important nowadays
   c. Cite 3 areas that computer vision that will help you on your everyday life.
5. Do wrap up discussion on what they think about they learned today.

Recommended Assessment(s)

- Have students fill out Reflection Worksheet (grade for participation)

List of Materials/Resources Used
- PowerPoint
- NEARPOD.com (students answer questions/classwork)

Part B - Estimate large crowds

Suggested Length of Lesson: 2 Days

Materials/Technology Needed

- Lap top
- Power point
- NEARPOD.COM
- Camera or cell phone (take pictures)
- Microsoft Word (manual count crowd)

Where this Fits

- Activity where the students learn about different methods for count a large crowd – manually and user a crowd counting software.

Lesson Objective(s)/Learning Goal(s)

- Students will be able to describe different methods for crowd counting.
- Students will be able to create an algorithm to solve a problem
- Students will be able to identify the best method to solve a problem

Standard(s)/Benchmark(s) Addressed

- *SC.912.CS-CS.2.13 Explain how automated software testing can reduce the cost of the testing effort.*
- *SC.912.CS-CS.2.14 Explain what tools are applied to provide automated testing environments.*
- *SC.912.CS-CS.3.1 Describe digital tools or resources to use for a real-world task based on their efficiency and effectiveness.*
- *SC.912.CS-CS.1.1 Analyze data and identify real-world patterns through modeling and simulation.*
- *SC.912.CS-CS.2.10 Design and implement a simple simulation algorithm to analyze, represent, and understand natural phenomena.*

Standards for Mathematical Practice

- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others
- Model with mathematics
- Look for and express regularity in repeated reasoning

Instructional Strategies

- *Monitoring Progress*
  - Reflection/Response class questioning and written reflections
- *Compare and Contrast*
  - Different machine learning algorithms
- *Graphing Organizers*
  - Charts and diagrams explaining algorithms

Evidence of Learning (Assessment Plan)

- Students will take a picture of a large crowd and find a best method to count manually.
- Students will count a part of a large crowd picture (more than 500 people), compare the precision of counting and the length of time to estimate manually with the UCF software Crowd Counting.

Description of Lesson Activity/Experiences

1. *Go through attached presentation*
2. *Have students create an algorithm to count a large crowd in a picture (NEARPOD)*
3. *Show the class some of the students algorithm:*
   - *Use a good and a bad example*
   - *Class discussion why is important to have a clear and detailed algorithm*
4. *Students will count a crowd using Jacob's Method*
   - *Divide the picture in a grid*
   - *Choose one grid and count how many people are in it*

- *Multiply by the number of grids = estimated number of people in the picture*

5. *Students answer question " PROS AND CONS OF USING JACOB'S METHOD"*
   - Show some answers and question about time used, precision and accuracy
6. *Do wrap up discussion on what they noticed and why they think that was happening*
   - ***This may need to take place at the start of your next class depending on timing***

Recommended Assessment(s)

- Algorithm for crowd counting
- Have students fill out Reflection Worksheet (grade for participation)

List of Materials/Resources Used

- Poster of large crowd, laminated and divided in 10 squares (to count how many people in each square)
- PowerPoint – 13 slides
- Software Crowd count – UCF – Computer vision department (PhD student Muhammed Tayyab)

Part C - EDGE DETECTION

Suggested Length of Lesson: 1 Day

Materials/Technology Needed
- Lap top
- Power point
- NEARPOD.COM

Where this Fits
- Activity where the students learn about how a computer detect and edge for count crowd or images using convolution method

Lesson Objective(s)/Learning Goal(s)
- Students will be able to describe a method to detect edges in an image.
- Students will be able to calculate manually an edge of picture

Standard(s)/Benchmark(s) Addressed
- *SC.912.CS-CS.2.14 Explain what tools are applied to provide automated testing environments.*
- *SC.912.CS-CS.3.1 Describe digital tools or resources to use for a real-world task based on their efficiency and effectiveness.*
- *SC.912.CS-CS.1.1 Analyze data and identify real-world patterns through modeling and simulation.*

Standards for Mathematical Practice
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others
- Model with mathematics
- Look for and express regularity in repeated reasoning

Instructional Strategies
- *Monitoring Progress*
  - Reflection/Response class questioning and written reflections
- *Compare and Contrast*
  - Different machine learning algorithms
- *Graphing Organizers*
  - Charts and diagrams explaining algorithms

Evidence of Learning (Assessment Plan)
- Students will calculate using convolution method, a part of an image.
- Students will explain the different methods for edge detection

Description of Lesson Activity/Experiences
1. *Show Students what is Edge Detection and some examples*
2. *Show students different methods for edge detection*
3. *Students practice edge detection – convolution*
4. *Do wrap up discussion on what they noticed and why they think that was happening*

Recommended Assessment(s)
- *edge detection – convolution* for a black white image
- Have students fill out Reflection Worksheet (grade for participation)

List of Materials/Resources Used
- Worksheet with edge detection example and on practice
- PowerPoint – 16 slides
- YouTube videos
- Power point lesson – Dr. Lobo

Important Vocabulary

Term	Definition
Algorithm	*A process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer.*
Artificial Intelligence	*The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.*
Binary Decision Making	*Is a choice between two alternatives, for instance between taking some specific action or not taking it.*
Boosting	*A machine learning ensemble meta-algorithm for primarily reducing bias, and also variance in supervised learning, and a family of machine learning algorithms which convert weak learners to strong ones.*
Machine Learning	*A type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed.*
Mathematical Weighting	*Is a mathematical device used when performing a sum, integral, or average to give some elements more "weight" or influence on the result than other elements in the same set.*
Neural Network	*A computer system modeled on the human brain and nervous system.*
Supervised Learning (in terms of computers)	*Is the **machine learning** task of inferring a function from labeled **training** data.*
Unsupervised Learning	*A learning techniques that group instances without a pre-specified dependent attribute. Clustering algorithms are usually unsupervised.*

Troubleshooting Tips

1. If students are having a hard time understanding the Neural Network example it may be helpful to use an example of grading a test.
    a. You have a test whose grade should be an 85 with 5 FRQs
    b. Each “algorithm” is the grade on each question
    c. Random weights are used to calculate their grade but the algorithm gets a wrong value
    d. You adjust weights some way and try again till you get right value.
    e. Then use that model for all other tests.

Other Helpful Information

1. Students may be slightly confused as you progress through some of the examples remind them that they are not required to know all of this at this time. This is a preview of the things they can look deeper into in the future or in college but at no means is required at any level if they don’t want to.

Attachments (not done yet)

- PowerPoint

References

[Flex Box]. (2017, January 4). NVIDIA CES 2017 Keynote. Retrieved from

https://youtu.be/jmY2LXy-hXU

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