UCF RET Site: Research Experiences in Computer Vision and Crowd Counting & Data Collection Lesson Plan

AP Computer Science Principles

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## RET Site: Research Experiences in Computer Vision and Crowd Counting Lesson Plan

**Course:** AP Computer Science Principles  
**Grade Level:** 9th – 12th Grade  
**Suggested Length of Lesson:** 2-3 days

### Materials/Technology Needed
- Presentation Capability (power point)  
- Ability to show python programing  
  - (Extra not necessary)

### Where this Fits
- As an extension activity after students learn about how computers work and how to create and use algorithms. As well as understanding the importance of the collection of Data.

### Lesson Objective(s)/Learning Goal(s)
- Students will be able to describe Crowd Counting the utilization of it within “Big Data” and data collection  
- Student will understand the importance of Data Collection and where CROWD COUNTING fits into Data  
- Students will be able to compare and contrast machine learning methods, AI and Computer Vision applications

### Standard(s)/Benchmark(s) Addressed
- Standards:  
  - **EK 4.1.1H:** Different algorithms can be developed to solve the same problem  
  - **EK 4.2.3B:** A decidable problem is one in which an algorithm can be constructed to answer “yes” or “no” for all inputs  
  - **EK 4.2.4E:** Sometimes, more efficient algorithms are more complex

### Standards for Mathematical Practice

### 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 be able to work in groups and collaborate in a humanistic approach of creating a counting algorithm.

### Description of Lesson Activity/Experiences:

#### Pre-Work:
- “DATA Collection Project”  
  - Your assignment is to collect images of crowds or groups of people (preferably 25 people or better).  
  - Images should be:  
    - Best Quality  
    - 50-100 or more  
    - Consistent (if possible Location, day, time)  
    - Minimum 7 Images

#### Day 1
- Go through attached presentation: Computer Vision UCF/RET  
  - Computer Vision  
  - How Computers see things?  
  - Scene Classification  
  - Edge Detection  
  - A.I.  
  - Neural Network Video (Homework/Edpuzzle)
Day 2
- Go through attached presentation: Crowd Counting (NEARPOD)
  - What is Big Data?
  - The Value of Big Data?
  - What is Big Data being used for?
  - What is Crowd Counting?
  - UCF’s Research
  - Real Life Applications
    - Data collection, Security, Attendance large demonstrations, Targeting, etc
- Build teams. Go thru activity with images.
  - Review group answers
    - Based on the image given where do you feel the image was taken?
    - Based on the image, How many people were at the event?
    - How did you as a team come up with that number? Was there a process/algorithm used? What was it?
    - Why do you think that number is important to know?
- Discuss group counting Algorithm
  - Jacob’s Method Overview
- Data/Picture Collection project
  - Pictures collected by students – “Data Collection” Project
    - What were the details of the images taken?
    - Based on your images, Use website to determine how many people were in each image.
    - What is a good evaluation and description of the images and data that you have collected
- Wrap up discussion.

Day 3 & 4:
- EXPLORE TASK Practice:
  - Pick a UCF Research Project from [http://crcv.ucf.edu/research](http://crcv.ucf.edu/research)
  - Create a 1 page write up. Answer these questions:
    - What is the purpose or function of this research?
    - How does this “research” impact society, the economy, or culture?
    - Describe how the “research” are beneficial AND how they may be harmful?

Recommended Assessment(s) and Steps
- Have students fill out Worksheet as a group and check algorithms with other groups and compare to the computer algorithms.
- Have students as individuals fill out Worksheets, reflecting on the set of pictures collected during “Data Collecting” project.
  - Don’t forget to make them explain their answers as this will what makes them and rest of the class think. May also create disagreement and discussion.

List of Materials/Resources Used
- Worksheet – 2 pages, Image worksheet and counting
- PowerPoint –
### Important Vocabulary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td><strong>Algorithm</strong></td>
<td>A process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer.</td>
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<tr>
<td><strong>Artificial Intelligence</strong></td>
<td>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.</td>
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<td><strong>Big Data</strong></td>
<td>A term for datasets so large or complex that traditional data processing applications are inadequate.</td>
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<td><strong>Boosting</strong></td>
<td>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.</td>
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<td><strong>Machine Learning</strong></td>
<td>A type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed.</td>
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<td><strong>Crowd Counting</strong></td>
<td>A technique used to count or estimate the number of people in a crowd.</td>
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<td><strong>Neural Network</strong></td>
<td>A computer system modeled on the human brain and nervous system.</td>
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<td><strong>Supervised Learning</strong></td>
<td>Is the machine learning task of inferring a function from labeled training data.</td>
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<td>(in terms of computers)</td>
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<td><strong>Unsupervised Learning</strong></td>
<td>A learning techniques that group instances without a pre-specified dependent attribute. Clustering algorithms are usually unsupervised.</td>
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References


https://youtu.be/jmY2LXy-hXU
Acknowledgements

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