Unit 7 Recursion

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Recursion - Computer Science A

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP Computer Science A

Recursion

Belleville Board of Education

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Board Approved:

Unit Overview

In this unit students will learn how to apply recursion in Java. We will cover several methods for recursion, including factorials, Fibonacci series, and the Tower of Hanoi game. Working code examples are provided.

Recursion: Calling Yourself

Imagine leaving a building that has a revolving door. Instead of exiting the building, you keep going around and around again, until someone tells you to exit (or you pass out from dizziness). In programming, a **recursive** method is like this: it calls itself over and over until something triggers its exit.

Recursion is considered a concise and advanced way of programming. These characterizations stem from the limited lines of code required as opposed to other, more verbose approaches.

Sometimes a problem can be solved by solving smaller or simpler versions of the same problem rather than attempting an iterative solution.

This is called recursion, and it is a powerful math and computer science idea.

In this unit, students will revisit how control is passed when methods are called, which is necessary knowledge when working with recursion.

Enduring Understanding

What real-world processes do you follow that are recursive in nature?

Why do programmers sometimes prefer using recursive solutions when sorting data in a large data set?

Recursion in computer science is a method where the solution to a problem depends on solutions to smaller instances of the same problem (as opposed to iteration).

The approach can be applied to many types of problems, and recursion is one of the central ideas of computer science.

Essential Questions

Which of the following conditions must be true in order to search for a value using binary search?

```
I. The values in the array must be integers.
II. The values in the array must be in sorted order.
III. The array must not contain duplicate values.
```

What is Recursion?

Which line in the method factorial contains the recursive call (the call to the same method)?

Exit Skills

Determine an appropriate program design to solve a problem or accomplish a task (not assessed). 3.B Write program code to define a new type by creating a class. 9.2 Writing Constructors for Subclasses 3.B Write program code to define a new type by creating a class. 5.A Describe the behavior of a given segment of

program code. 9.3 Overriding Methods 3.B Write program code to define a new type by creating a class. 5.D Describe the initial conditions that must be met for a program segment to work as intended or described. 9.4 super Keyword 1.C Determine code that would be used to interact with completed program code. 3.B Write program code to define a new type by creating a class. 9.5 Creating References Using Inheritance Hierarchies 3.A Write program code to create objects of a class and call methods. 5.B Explain why a code segment will not compile or work as intended. 9.6 Polymorphism 3.A Write program code to create objects of a class and call methods. 5.B Explain why a code segment will not compile or work as intended. 9.7 Object Superclass 1.C Determine code that would be used to interact with completed program code. 3.B Write program code to define a new type by creating a class

New Jersey Student Learning Standards (NJSLS-S)

CS.9-12.8.1.12.CS.1	Describe ways in which integrated systems hide underlying implementation details to simplify user experiences.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.
CS.9-12.8.1.12.CS.3	Compare the functions of application software, system software, and hardware.
CS.9-12.CS	Computing Systems
CS.9-12.NI	Networks and the Internet
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
	The scalability and reliability of the Internet are enabled by the hierarchy and redundancy in networks. Network topology is determined by many characteristics.

Interdisciplinary Connections

LA.RL.9-10	Reading Literature
	Key Ideas and Details
LA.RL.9-10.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
LA.RL.11-12.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
LA.RL.11-12.2	Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.
LA.RL.9-10.2	Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details and provide an objective summary of the text.
LA.RL.9-10.3	Analyze how complex characters (e.g., those with multiple or conflicting motivations) develop over the course of a text, interact with other characters, and advance the plot or develop the theme.
LA.RL.11-12.3	Analyze the impact of the author's choices regarding how to develop and relate elements of a story or drama (e.g., where a story is set, how the action is ordered, how the characters are introduced and developed).
LA.RI.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
LA.RI.11-12.2	Determine two or more central ideas of a text, and analyze their development and how they interact to provide a complex analysis; provide an objective summary of the text.
LA.L.11-12.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies.
LA.L.11-12.4.A	Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
LA.L.11-12.4.B	Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., conceive, conception, conceivable).
LA.L.11-12.4.C	Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, its etymology, or its standard usage.

Learning Objectives

Apply recursive search algorithms to information in String, 1D array, or ArrayList objects.

Data must be in sorted order to use the binary search algorithm.

Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.

Suggested Activities & Best Practices

Personal Progress Check 10 Multiple-choice: ~10 questions Free-response: 1 question § Methods and Control Structures (recursive and non-recursive solutions allowed)

10.1 Sharing and responding Provide students with the pseudocode to multiple recursive algorithms, and have students write the base case of the recursive methods and share it with their partner. The partner should then provide feedback, including any corrections or additions that may be needed. 2 10.1 Look for a pattern Provide students with a recursive method and several different inputs. Have students run the recursive method, record the various outputs, and look for a pattern between the input and related output. Ask students to write one or two sentences as a broad description of what the recursive method is doing. 3 10.2 Code tracing When looking at a recursive method to determine how many times it executes, have students create a call tree or a stack trace to show the method being called and the values of any parameters of each call. Students can then count up the number of times a statement executes or a method is called.

- -Student will be able to identify famous African Americans in the field of computer programming
- Students will also be introduced to the basic energy efficient models in the programming field to help reduce global warming

Assessment Evidence - Checking for Understanding (CFU)

Runestone Academy: AP CSA—Java Review: 12—Recursion - Practice-It!: BJP4 Chapter 12: Recursion—Self Check 12.3–12.6, 12.13–12.15 § Coding Bat Java: Recursion

Formative Evaluations:	**Summative Evaluations:**
Formative Assessment with polling codeIt! Nows Quizzes Long Programs (LP)/Lab Work Components of AP approved Lab	Unit Test/ReTest-Summative Assessment

Web-based Assessment-Alternate Assessment

Create a Multimedia poster-Benchmark Assessment

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments

- Written Reports

Primary Resources & Materials

NJCTL Curriculum

https://runestone.academy/runestone/books/published/csawesome/Unit10-Recursion/toctree.html?highlight=recursion

Curriculum development Resources/Instructional Materials/Equipment Needed Teacher Resources: • www.gliffy.com • Eclipse IDE • MS DOS Prompt • Computers

Ancillary Resources

Java Resources

- Java Review for the AP CS A Exam - Great review site with lots of practice questions.
- Aplus Compter Science Exam Review Material -Slide, Free Response, and more!
- Introduction to Java - a textbook for a first course in computer science for the next generation of scientists and engineers
- Guru-99 Introduction Java Material
- Oracles (owners of Java) has their own tutorials
- Dick Baldwin - ACC - Introduction and Advanced Java Material
- Introduction to Computer Science using Java - by Bradley Kjell
- Thinking in Java
- Blue Pelican Java
- Java Coding Bat - Lots of good practice problems
- Code Academy - No Java but good practice.

https://chortle.ccsu.edu/CS151/cs151java.html

Technology Infusion

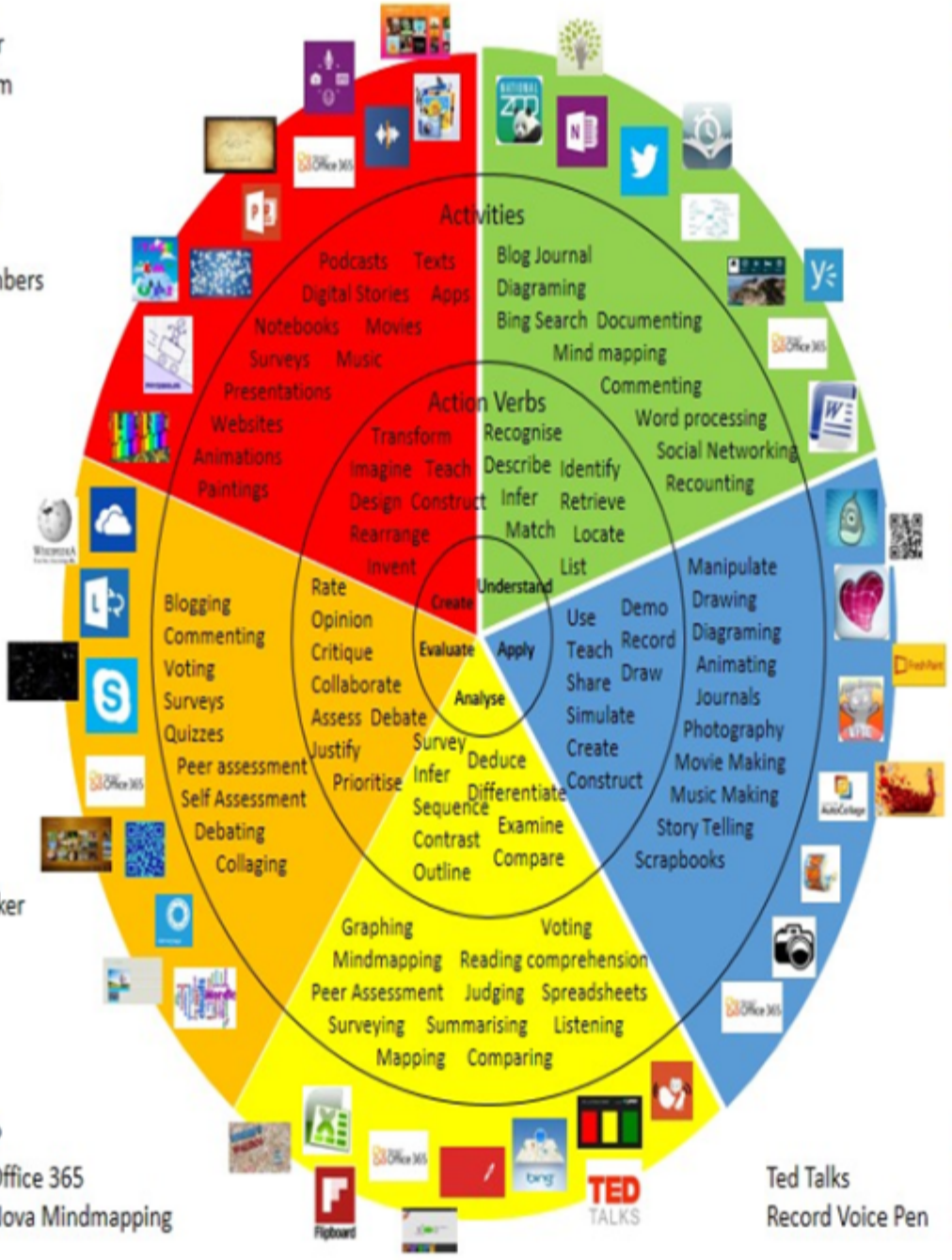
Technology Infusion and/or strategies include chromebooks online materials google/powerpoint slides

Technology Infusion and/or strategies are integrated into this unit to enhance learning

Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker



Where's Waldo?
MS Excel
Flipboard
Office 365
Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

Alignment to 21st Century Skills & Technology

WRK.9.2.12.CAP	Career Awareness and Planning
WRK.9.2.12.CAP.1	Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.
WRK.9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
WRK.9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
WRK.9.2.12.CAP.7	Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
	Innovative ideas or innovation can lead to career opportunities.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.

21st Century Skills/Interdisciplinary Themes

21st Century/Interdisciplinary Themes that will be incorporated into this unit.

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

	Functions
	Determining an output value for a particular input involves evaluating an expression; finding inputs that yield a given output involves solving an equation. Questions about when two functions have the same value for the same input lead to equations, whose solutions can be visualized from the intersection of their graphs. Because functions describe relationships between quantities, they are frequently used in modeling. Sometimes functions are defined by a recursive process, which can be displayed effectively using a spreadsheet or other technology.
	Connections to Expressions, Equations, Modeling, and Coordinates.

21st Century Skills

21st Century Skills that will be incorporated into this unit.

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

CAEP.9.2.12.C	Career Preparation
CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.

Differentiation

Exemplar: Study guides

Differentiation in a lesson lies within content, process, and/or product.

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products

- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

Special Education Learning adaptations that could be employed in this unit, using the ones identified below.

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation

- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Exemplar:

Students are assigned a partner for tutoring and assistance in class

Students are given fewer choices on quizzes and tests.

English Language Learning adaptations that will be employed in the unit, using the ones identified below.

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test

- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

Assignments

Exemplar: The student at risk will need many assignments modified or reduced. Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may make jot notes and give you the information verbally, or it just may be that you will need to assign an alternate assignment.

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

Exemplar:

Students will create a blog or social media page a topic of their choice within the unit

http://www.grandviewlibrary.org/CurriculumAdaptations/General_Gifted.pdf

Grouping • Group gifted students with other gifted students or higher-level learners. • Refrain from grouping gifted students with lower-level students for remediation.

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

Unit 8 Lesson Plan – Recursion

Teacher:	Corey Woodring	Time Frame:	9 days
Grade:	9-12	School:	Belleville High School
Subject:	AP Computer Science A		

AP Essential Knowledge

(Referenced from CollegeBoard AP CS A Course & Exam Description)

- Determine the result of executing recursive methods.
- A recursive method is a method that calls itself.
- Recursive methods contain at least one base case, which halts the recursion, and at least one recursive call.
- Each recursive call has its own set of local variables, including the formal parameters.

- Parameter values capture the progress of a recursive process, much like loop control variable values capture the progress of a loop.
- Any recursive solution can be replicated through the use of an iterative approach.
    a. EXCLUSION STATEMENT— Writing recursive program code is outside the scope of the course and AP Exam.
- Recursion can be used to traverse String, array, and ArrayList objects.

Enduring Understanding & CTP Skills

(Referenced from CollegeBoard AP CS A Course & Exam Description)
CON-2 Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.

1.B Determine code that would be used to complete code segments.

2.C Determine the result or output based on the statement execution order in a code segment containing method calls.

2.D Determine the number of times a code segment will execute.

5.A Describe the behavior of a given segment of program code.

1. Essential Questions

2. (Some referenced from CollegeBoard AP CS A Course & Exam Description) 1.

(What questions will the student be able to answer as a result of the instruction?)

1. What real-world processes do you follow that are recursive in nature?
2. How do you trace recursion?
3. What is a base case and why is it important?

1. Assessment

(What is acceptable evidence to show desired results (rubrics, exam, etc.)? Attach Copy

- Complete various written checkpoint exercises that focus on the explanation and description of computer hardware and Java basics.
- Develop a visual representation of the communication processes within a computer using

appropriate terminology.

- Properly document a program using correct indentation, spacing, and comment style.
- Debug programs and determine the types of errors in the program.
- Create programs based on programming exercises that display various types of output using string and numeric expressions.
- Unit 7 Assessment

Formative Evaluations:

Formative Assessment with polling

codeIt! Nows

Quizzes

AP Classroom AP Computer Science A Topic Questions

Long Programs (LP)/ Lab work

Summative Evaluations:

Unit 8 Test/ReTest

AP Classroom AP Computer Science A Progress Checks

Sequence and Scope

Day	Topic/Activities	CW-HW
1	• Recursion • The Base Case	None
2	• Tracing Recursion • Problems #1-2	Problems #3-6
3	• Two-Directional Recursion • Problem #7	Problems #8-9, AP Classroom topic questions 10.1 – 10.2
4	• Quiz Questions #1 (Optional) • LP Lucas Tower	LP Lucas Tower
5	• Recursion with Objects • codeIt! Now	Problems #10-13
6	• Recursion Beyond AP • codeIt! Now	LP Lucas Tower
7	• Finish Recursion Beyond AP	LP Lucas Tower

8	• LP Lucas Tower	Study for Test
9	• Unit 8 Assessment	None

CS.9-12.8.1.12.NI.1	Evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing.
CS.9-12.8.1.12.NI.2	Evaluate security measures to address various common security threats.
CS.9-12.8.1.12.NI.3	Explain how the needs of users and the sensitivity of data determine the level of security implemented.
CS.9-12.8.1.12.NI.4	Explain how decisions on methods to protect data are influenced by whether the data is at rest, in transit, or in use.
CS.9-12.NI	Networks and the Internet
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
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TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
	Innovative ideas or innovation can lead to career opportunities.
	With a growth mindset, failure is an important part of success.