



Mathematics
Grade 12
Advanced Computer Programming

Dr. Mark Toback, Superintendent
Committee: Thomas Grasso

*This curriculum may be modified through varying techniques, strategies,
and materials as per an individual student's Individualized Educational
Plan (IEP)*

Wayne School District Curriculum Format

Content Area/ Grade Level/ Course:	Mathematics 12 Advanced Programming
Unit Plan Title:	Unit 1. Arrays, Polymorphism, Hierarchies
Time Frame	10 weeks
Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Algebra	
Data and Analysis	DA
Algorithms and Programming	AP
Engineering Design	ED
Computer Systems	CS
21st Century Life Skills	9.1.12.F
21st Career Awareness, Exploration & Preparation	9.3.12.C
Career & Technical Education	9.4.12.A
Career & Technical Education	9.4.12.B
Unit Overview	
Unit 1. Arrays, Polymorphism, Hierarchies	
<ul style="list-style-type: none"> ● Review of arrays, polymorphism, hierarchies.dramatically ● Use of object oriented programming can improve code. ● Code reuse. ● Use arrays to store objects more effectively. ● Review arrays, polymorphism, and hierarchies. ● Store different types in the same arrays using polymorphism. ● Casting ● Use student made hierarchies. ● Use of animation and sprites. ● Use an interface and polymorphism to create a comprehensive project. 	
Standard Number(s) * i.e: Math: F.LE.A.4 i.e.: NJLSA.R4.	
<p>8.1.12.CS.1: Describe ways in which integrated systems hide underlying implementation details to simplify user experiences.</p> <p>8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.</p> <p>8.1.12.AP.1: Design algorithms to solve computational problems using a combination of original and existing algorithms.</p> <p>8.1.12.AP.2: Create generalized computational solutions using collections instead of repeatedly using simple variables.</p> <p>8.1.12.AP.3: Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice.</p> <p>8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue.</p> <p>8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using</p>	

constructs such as procedures, modules, and/or objects

8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.

8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.

8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and Accessible

8.1.12.AP.9: Collaboratively document and present design decisions in the development of complex programs.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.

9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

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).

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a)

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.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

WHST.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.11-12.6. Use technology, including the Internet, to produce, share, and update writing products in response to ongoing feedback, including new arguments or information.

NJSLSA.SL1. - Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

SL.11-12.4 - Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

HS-ETS1-2. - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-4. - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Intended Outcomes - {Essential Questions}

Unit 1. Arrays, Polymorphism, Hierarchies

- How can arrays and Arraylists be used to hold different data types using polymorphism?
- How can using object oriented programming can make a coder more effective?
- How does using polymorphism help a coder?
- How does having a well thought out hierarchy help with code reuse?
- How can you use interfaces and polymorphism to create dynamic code?

Enduring Understandings

- Arrays can be used to store different data types using polymorphism and casting.
- Interfaces and polymorphism can also be used with arrays to organize data.
- Creating hierarchies can help with object oriented programming and code reuse.
- Planning is an important step in the problem solving process that should not be overlooked.

In this unit plan, the following 21st Century themes and skills are addressed.

<i>Check all that apply.</i> 21st Century Themes		<i>Indicate whether these skills are E-Encouraged, T-Taught, or A-Assessed in this unit by marking E, T, A on the line before the appropriate skill.</i> 21st Century Skills	
X	Global Awareness	ETA	Creativity and Innovation
<input type="checkbox"/>	Environmental Literacy	ETA	Critical Thinking and Problem Solving
<input type="checkbox"/>	Health Literacy	ETA	Communication
<input type="checkbox"/>	Civic Literacy	ETA	Collaboration
X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Students will know how to create and modify an array and an ArrayList.
- Students will know how to create their own hierarchy.
- Students will know how to use object oriented programming to make their code more effective.
- Students will understand the idea of polymorphism.
- Students will understand how planning out their projects is important.
- Students will use polymorphism to create dynamic code.

Assessments (Pre, Formative, Summative, Other)

*Denote required common assessments with an **

Students will work from a program specification to build their own creative solutions to problems. By its very nature the course is highly differentiated and each student is free to develop advanced features and enhancements beyond those required for a basic solution. The introduction of GUI (Graphic User Interfaces) early in the course further increases student options for creating exceptional graphics based applets and applications in addition or in place of a console based solution. Backwards Design in the discussion of a program solution will be featured regularly as we carefully consider which type of designs will provide for optimal solutions given the tools that students have acquired to date.

Formative and summative evaluations in the form of worksheets, quizzes and tests - both paper based and computer based will be utilized as needed to reinforce learning objectives and evaluate student progress.

One suggestion is to create a grid based project that will use the elements of all the above topics. Students can create a grid that will hold different type of sprites that will be put into a hierarchy. The sprite displayed can be of any type depending on the user or computer traversing through the grid. The students then can create a maze that each sprite will solve differently. One will randomly walk around, one will hug the right wall, and the

third will “remember” where it’s been as not a solution. Common methods should be put into an interface and casted accordingly. This is similar to the discontinued AP Computer Science A “Grid World” except the students will create the project from scratch rather than using the foundation giving by AP.

Teaching and Learning Activities

<p><i>Activities</i></p>	<ul style="list-style-type: none"> • Lecture and class discussion. • Video and multimedia presentations. • Build a console, applet and GUI based application. • Review and extend program functionality. • Group and collaborative work. • Student presentations of projects.
<p><i>Differentiation Strategies</i></p>	<ul style="list-style-type: none"> • Individual and collaborative research, design and problem solving • Student interest and skill level assessment • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons
<p><i>Honors</i></p>	

Resources

- <http://www.state.nj.us/education/cccs/>
- <http://www.corestandards.org/ELA-Literacy>
- <http://www.state.nj.us/education/cccs/>

**Wayne School District
Curriculum Format**

Content Area/ Grade Level/ Course:	Mathematics 12 Advanced Programming
Unit Plan Title:	Unit 2. Linear Data Structures
Time Frame	7 weeks
Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Algebra	
Data and Analysis	DA
Algorithms and Programming	AP
Engineering Design	ED
21st Century Life Skills	9.1.12.F
21st Career Awareness, Exploration & Preparation	9.3.12.C
Career & Technical Education	9.4.12.A
Career & Technical Education	9.4.12.B
Unit Overview	
<p>Unit 2. Linear Data Structures</p> <ul style="list-style-type: none"> ● Understanding/Creating Linked List ● Organizing data using Linked List ● Understanding/Creating Doubley Linked List ● Organizing data using a Doubley Linked List ● Understanding/Creating Stacks ● Organizing data using Stacks ● Understanding/Creating Queues ● Organizing data using Queues ● Deciding which Linear Data structure is best for a given scenario 	
Standard Number(s) * i.e: Math: F.LE.A.4 i.e.: NJLSA.R4.	
<p>8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.</p> <p>8.1.12.AP.1: Design algorithms to solve computational problems using a combination of original and existing algorithms.</p> <p>8.1.12.AP.2: Create generalized computational solutions using collections instead of repeatedly using simple variables.</p> <p>8.1.12.AP.3: Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice.</p>	

8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue.

8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.

8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.

8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and Accessible

8.1.12.AP.9: Collaboratively document and present design decisions in the development of complex programs.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.

9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

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).

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a)

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.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

WHST.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.11-12.6. Use technology, including the Internet, to produce, share, and update writing products in response to ongoing feedback, including new arguments or information.

NJSLSA.SL1. - Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

SL.11-12.4 - Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

HS-ETS1-2. - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-4. - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Intended Outcomes - {Essential Questions}

Unit 2. Linear Data Structures

- What is a Linked List and how is it different than an Array?
- How do you add, remove, and find objects in a Linked List?
- What problems/data sets would a Linked List be useful for?
- What is Doubly Linked List and how is it different from a Linked List?
- Does the process change for adding, removing, and finding objects in a Doubly Linked List versus a Linked list?
- What problems/data sets would a Doubly Linked List be useful for?

- What is a Stack and how is it different than a Linked List?
- How do you add, remove, and find object in a Stack?
- What problems/data sets would a Stack be useful for?
- What is a Queue and how is it different than a Stack?
- How do you add, remove, and find objects in a Queue?
- What problems/data sets would a Queue be useful for?

Enduring Understandings

- Developing and managing Linked List and Doubly Linked List.
- Developing and managing Stacks and Queues.
- Understanding which Linear Data Structure should be used for a given application.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. 21 st Century Themes		Indicate whether these skills are E-Encouraged , T-Taught , or A-Assessed in this unit by marking E , T , A on the line before the appropriate skill. 21 st Century Skills	
<input checked="" type="checkbox"/>	Global Awareness	<input type="checkbox"/> ETA	Creativity and Innovation
<input type="checkbox"/>	Environmental Literacy	<input type="checkbox"/> ETA	Critical Thinking and Problem Solving
<input type="checkbox"/>	Health Literacy	<input type="checkbox"/> ETA	Communication
<input type="checkbox"/>	Civic Literacy	<input type="checkbox"/> ETA	Collaboration
<input checked="" type="checkbox"/>	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Students will know how to create and modify a Linked List
- Students will know how to create and modify a Doubly Linked List
- Students will know how to create and modify a Stack
- Students will know how to create and modify a Queue
- Students will be able to implement the various Linear Data structures
- Students will know which data structure is appropriate for a given application

Assessments (Pre, Formative, Summative, Other)

*Denote required common assessments with an **

Students will work from a program specification to build their own creative solutions to problems. By its very nature the course is highly differentiated and each student is free to develop advanced features and enhancements beyond those required for a basic solution. The introduction of GUI (Graphic User Interfaces) early in the course further increases student options for creating exceptional graphics based applets and applications in addition or in place of a console based solution. Backwards Design in the discussion of a program solution will be featured regularly as we carefully consider which type of designs will provide for optimal solutions given the tools that students have acquired to date.

Formative and summative evaluations in the form of worksheets, quizzes and tests - both paper based and computer based will be utilized as needed to reinforce learning objectives and evaluate student progress.

One suggestion is to create a project that will use the elements of all the above topics. Students can create a project that requires the organization and access to a set of data. Examples can include customers on a line at a store, modeling a card game, organizing high scores, etc...

Teaching and Learning Activities

<i>Activities</i>	<ul style="list-style-type: none"> • Lecture and class discussion. • Video and multimedia presentations. • Build a console, applet and GUI based application. • Review and extend program functionality. • Group and collaborative work. • Student presentations of projects.
<i>Differentiation Strategies</i>	<ul style="list-style-type: none"> • Individual and collaborative research, design and problem solving • Student interest and skill level assessment • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons
<i>Honors</i>	

Resources

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Wayne School District Curriculum Format

Content Area/ Grade Level/ Course:	Mathematics 12 Advanced Programming
Unit Plan Title:	Unit 3. Non- Linear Data Structures
Time Frame	7 weeks
Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Algebra	

Data and Analysis	DA
Algorithms and Programming	AP
Engineering Design	ED
21st Century Life Skills	9.1.12.F
21st Career Awareness, Exploration & Preparation	9.3.12.C
Career & Technical Education	9.4.12.A
Career & Technical Education	9.4.12.B

Unit Overview

Unit 3. Non- Linear Data Structures

- Understanding/Creating binary trees
- Organizing data using binary trees
- Understanding/Creating hash tables
- Organizing data using a hash tables
- Deciding if a linear or non- linear structure is best for a given scenario
- If non- linear, deciding which structure is best.

Standard Number(s) * i.e: Math: F.LE.A.4 i.e.: NJLSA.R4.

8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

8.1.12.AP.1: Design algorithms to solve computational problems using a combination of original and existing algorithms.

8.1.12.AP.2: Create generalized computational solutions using collections instead of repeatedly using simple variables.

8.1.12.AP.3: Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice.

8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue.

8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.

8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.

8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and Accessible

8.1.12.AP.9: Collaboratively document and present design decisions in the development of complex programs.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.

9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

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).

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a)

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.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

WHST.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.11-12.6. Use technology, including the Internet, to produce, share, and update writing products in response to ongoing feedback, including new arguments or information.

NJSLSA.SL1. - Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

SL.11-12.4 - Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

HS-ETS1-2. - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-4. - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Intended Outcomes - {Essential Questions}

Unit 3. Non- Linear Data Structures

- What is a non- linear data structure and how is it different than an linear structure?
- How do you add, remove, and find objects in a binary tree?
- What is preorder, inorder, and postorder traversal?
- What problems/data sets would a binary tree be useful for?
- How can you organize a binary tree so that it is balanced?
- What problems/data sets would a binary tree be useful for?
- What is a hash table?
- How do you add, remove, and find object in a hash table?
- What problems/data sets would a hash table be useful for?

Enduring Understandings

- Data structures hold different type of data.
- Certain structures are better or worse for different situations.
- All structures have advantages and weaknesses.
- How to add, remove, balance, and find data in a tree.
- How to implement the three tree traversals.
- Binary trees are useful when middle data is not changed often and is searched often.
- A hash table is a data structure that can find items quick.
- How to add, remove, balance, and find data in a table.
- Hash table are useful when data needs to be found quick, but they take up an enormous amount of space.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply.
21st Century Themes

Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.

		21 st Century Skills	
X	Global Awareness	ETA	Creativity and Innovation
	Environmental Literacy	ETA	Critical Thinking and Problem Solving
	Health Literacy	ETA	Communication
	Civic Literacy	ETA	Collaboration
X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

- Students will understand the difference in data structures.
- Students will know how to pick a data structure based on the nature of the data and how it will be used.
- Students will know the weaknesses and strengths of each structure.
- Students will understand how to modify a tree structure, especially a binary tree.
- Students will understand how to traverse a tree.
- Students will understand how planning out their projects is important.
- Students will understand how to add, remove, and search a hash table.
- Students will know when a table data structure is the best solution to a problem.

Assessments (Pre, Formative, Summative, Other)

*Denote required common assessments with an **

Students will work from a program specification to build their own creative solutions to problems. By its very nature the course is highly differentiated and each student is free to develop advanced features and enhancements beyond those required for a basic solution. The introduction of GUI (Graphic User Interfaces) early in the course further increases student options for creating exceptional graphics based applets and applications in addition or in place of a console based solution. Backwards Design in the discussion of a program solution will be featured regularly as we carefully consider which type of designs will provide for optimal solutions given the tools that students have acquired to date.

Formative and summative evaluations in the form of worksheets, quizzes and tests - both paper based and computer based will be utilized as needed to reinforce learning objectives and evaluate student progress.

One suggestion is to have students create their own binary tree class. Within this class, students will implement the add and remove methods. They will then balance the tree structure so that their tree is always height- balanced. They will also implement preorder, inorder, and postorder traversal.

Using their own class, students will use the traversal methods and put all the words in a book in order. They will then count how many times each word appears.

Teaching and Learning Activities

Activities

- Lecture and class discussion.
- Video and multimedia presentations.
- Build a console, applet and GUI based application.
- Review and extend program functionality.
- Group and collaborative work.

	<ul style="list-style-type: none"> • Student presentations of projects.
<i>Differentiation Strategies</i>	<ul style="list-style-type: none"> • Individual and collaborative research, design and problem solving • Student interest and skill level assessment • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons
<i>Honors</i>	
Resources	
<ul style="list-style-type: none"> • http://www.state.nj.us/education/cccs/ • http://www.corestandards.org/ELA-Literacy • http://www.state.nj.us/education/cccs/ 	

**Wayne School District
Curriculum Format**

Content Area/ Grade Level/ Course:	Mathematics 12 Advanced Programming
Unit Plan Title:	Unit 4. Multithreading and Networking
Time Frame	6 weeks
Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Algebra	
Data and Analysis	DA
Algorithms and Programming	AP
Engineering Design	ED
Networking and Internet	NI
21st Century Life Skills	9.1.12.F
21st Career Awareness, Exploration & Preparation	9.3.12.C
Career & Technical Education	9.4.12.A
Career & Technical Education	9.4.12.B
Unit Overview	
Unit 4. Multithreading and Networking	
<ul style="list-style-type: none"> • Understanding multithreading • Using and creating a threaded program • IP addresses 	

- Locating a computer on the network
- Server, clients, and sockets
- Data exchange and packets

Standard Number(s) * i.e: Math: F.LE.A.4 i.e.: NJSLA.R4.

8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

8.1.12.NI.1: Evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing.

8.1.12.NI.2: Evaluate security measures to address various common security threats.

8.1.12.AP.1: Design algorithms to solve computational problems using a combination of original and existing algorithms.

8.1.12.AP.2: Create generalized computational solutions using collections instead of repeatedly using simple variables.

8.1.12.AP.3: Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice.

8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue.

8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.

8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.

8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and Accessible

8.1.12.AP.9: Collaboratively document and present design decisions in the development of complex programs.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.

8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.

9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

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).

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a)

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.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

WHST.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.11-12.6. Use technology, including the Internet, to produce, share, and update writing products in response to ongoing feedback, including new arguments or information.

NJSLSA.SL1. - Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

SL.11-12.4 - Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

HS-ETS1-2. - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-4. - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Intended Outcomes - {Essential Questions}

Unit 4. Multithreading and Networking

- What is multithreading?
- how does the computer use the idea of multithreading to complete a task?
- How can multithreading be used in conjunction with a network?
- What is an IP address and how can you find one?
- How can you use an IP address to exchange information between two computers?
- What is a server?
- What is a client?
- What is a socket?
- What is a port?
- How does the computer send and receive information through a network?

Enduring Understandings

- Multithreading can be used complete tasks similitanously.
- Using multithreading, the computer can communicate with multiple computers at once.
- Using the computers IP address, a server can communicate with clients.

In this unit plan, the following 21st Century themes and skills are addressed.

<i>Check all that apply.</i> 21st Century Themes		<i>Indicate whether these skills are E-Encouraged, T-Taught, or A-Assessed in this unit by marking E, T, A on the line before the appropriate skill.</i> 21st Century Skills	
X	Global Awareness	ETA	Creativity and Innovation
<input type="checkbox"/>	Environmental Literacy	ETA	Critical Thinking and Problem Solving
<input type="checkbox"/>	Health Literacy	ETA	Communication
<input type="checkbox"/>	Civic Literacy	ETA	Collaboration
X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

-

Assessments (Pre, Formative, Summative, Other)

*Denote required common assessments with an **

Students will work from a program specification to build their own creative solutions to problems. By its very nature the course is highly differentiated and each student is free to develop advanced features and enhancements beyond those required for a basic solution. The introduction of GUI (Graphic User Interfaces) early in the course further increases student options for creating exceptional graphics based applets and applications in addition or in place of a console based solution. Backwards Design in the discussion of a program solution will be featured regularly as we carefully consider which type of designs will provide for optimal solutions given the tools that students have acquired to date.

Formative and summative evaluations in the form of worksheets, quizzes and tests - both paper based and computer based will be utilized as needed to reinforce learning objectives and evaluate student progress.

A suggested project would include creating a chat room where a server can communicate with clients. The chat room would have two functions. One where a message could be sent out to the entire group of computers connected to the network. The other would be a private message that would only go from one client to another. The users give a name when they connect to identify themselves with that computer. These names and IP addresses are entered into a hash table and accessed.

Another suggested project would be to take the classic game of pong and make it two players over a network. Both players would be able to use their own computer to control their own paddle, but also see their opponent's movement.

Teaching and Learning Activities

<i>Activities</i>	<ul style="list-style-type: none"> • Lecture and class discussion. • Video and multimedia presentations. • Build a console, applet and GUI based application. • Review and extend program functionality. • Group and collaborative work. • Student presentations of projects.
<i>Differentiation Strategies</i>	<ul style="list-style-type: none"> • Individual and collaborative research, design and problem solving • Student interest and skill level assessment • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons
<i>Honors</i>	

Resources

- <http://www.state.nj.us/education/cccs/>
- <http://www.corestandards.org/ELA-Literacy>
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**Wayne School District
Curriculum Format**

Content Area/ Grade Level/ Course:	Mathematics 12 Advanced Programming
Unit Plan Title:	Unit 5. 3D/ 2D Game Engine
Time Frame	10 weeks
Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Algebra	
Data and Analysis	DA
Algorithms and Programming	AP
Engineering Design	ED
Computer Systems	CS
21st Century Life Skills	9.1.12.F
21st Career Awareness, Exploration & Preparation	9.3.12.C
Career & Technical Education	9.4.12.A
Career & Technical Education	9.4.12.B
Unit Overview	
Unit 5. 3D/ 2D Game Engine <ul style="list-style-type: none"> ● Review of C# ● Setting up and exploring a game engine ● Getting assests ● Using an IDE ● Using a physics engine ● Review of collision and collision boxes 	
Standard Number(s) * i.e: Math: F.LE.A.4 i.e.: NJLSA.R4.	
8.1.12.CS.1: Describe ways in which integrated systems hide underlying implementation details	

to simplify user experiences.

8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

8.1.12.AP.1: Design algorithms to solve computational problems using a combination of original and existing algorithms.

8.1.12.AP.2: Create generalized computational solutions using collections instead of repeatedly using simple variables.

8.1.12.AP.3: Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice.

8.1.12.AP.4: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue.

8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects

8.1.12.AP.6: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.

8.1.12.AP.7: Collaboratively design and develop programs and artifacts for broad audiences by incorporating feedback from users.

8.1.12.AP.8: Evaluate and refine computational artifacts to make them more usable and Accessible

8.1.12.AP.9: Collaboratively document and present design decisions in the development of complex programs.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.

8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.

9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

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).

9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a)

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.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

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HS-ETS1-4. - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Intended Outcomes - {Essential Questions}

Unit 5. 3D 2D Game Engine

- What is a game engine?
- How can a game engine be used to create a game?
- What are some functions of a game engine?
- How do you get assets?
- What is a physics engine?
- What is a script?
- How can manipulating objects help make a game in a game engine?
- How do objects collide in a game engine?

Enduring Understandings

- A game engine is a higher level programming tool that focuses on overall game structure over minor details like drawing objects to the screen.
- Assets can usually be found in an asset store or you can import your own.
- A physics engine helps the programmer interact with their world. It controls how two object interact. For example gravity or the way two objects bounce off each other.
- Scripts can be attached to an object. These are snips of code that a programmer can write that will dictate the behavior of the object.
- A game, among other things, consists of assets, objects, scripts, and physics. Using these effectively can help produce a game.

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Student Learning Targets/Objectives (Students will know/Students will understand)

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Assessments (Pre, Formative, Summative, Other)

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Formative and summative evaluations in the form of worksheets, quizzes and tests - both paper based and computer based will be utilized as needed to reinforce learning objectives and evaluate student progress.

Suggested projects include creating a 3D platform game where the user can roll a ball around and collect items. The platform game will include gravity and collision. Points can be awarded based on the amount of items that are collected.

Another suggested project might include a space shooter much like "Galaga" where the user can control a space ship and destroy incoming asteroids. The programmer can use textures to wrap around each object to make them look more realistic. They can add enemies and code their movements and behaviors. If there is time, students can add the use of LEAP to allow touchless and motion control.

Teaching and Learning Activities

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