Apply Basic Math Skills to Create Scoring Schemes in a Simple Game

Unit: Programming

Problem Area: Utilize Math for Gaming

Lesson: Apply Basic Math Skills to Create Scoring Schemes in a Simple Game

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Describe the mathematical order of operations.**
2. **Define terms commonly used in game scoring schemes.**
3. **Write mathematical equations to satisfy scoring requirements for a simple game.**

Resources.

The following resources may be useful in teaching this lesson:

Dawson, Michael. *Beginning C++ Through Game Programming*, 2nd ed. Thomson Course Technology, 2007.

"Order of Operations Poster," *Really Good Stuff.com.* Accessed June 3, 2009. <http://www.reallygoodstuff.com/pdfs/154513.pdf>.

Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials
- ✓ Whiteboard or flip chart

Key Terms.

The following terms are presented in this lesson (shown in bold italics):

- arithmetic operators
- decrement
- design document
- health
- increment
- lives
- order of operations
- power
- score

Interest Approach.

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Divide the class into groups with three or four students. Distribute board games and cards, instructing each group to play a game. Upon completion of game play, each group should discuss the methods used for scoring the game. Then they should prepare and give a brief presentation to the class. Allow each group to explain how scoring worked in their game.

Game suggestions: Checkers, Scrabble®, Dominoes, Battleship®, Trivial Pursuit®, Go Fish, and Rummy. As an alternative to board games, you could use Internet-based games.

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Describe the mathematical order of operations.

Anticipated Problem: What is the mathematical order of operations?

I. ***Order of operations*** is the mathematical rule that states that arithmetic equations are evaluated from left to right in a particular order. Some ***arithmetic operators*** (symbols that indicate the type of calculation to occur) take higher precedence than others. The saying "**P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally" is often used to help students remember the order of operations. Without the order of operations in place, incorrect answers often result.

A. Rules

1. Rule 1—First, it is necessary to perform any calculations inside parenthesis (**P**).
2. Rule 2—Second, it is essential to perform any exponential (**E**) calculations, working from left to right.
3. Rule 3—Third, it is necessary to perform multiplication (**M**) and division (**D**) calculations, working from left to right.
4. Rule 4—Lastly, it is essential to perform addition (**A**) and subtraction (**S**) calculations, working from left to right.

B. Common arithmetic operators used in program code

1. The plus sign (+) is used for addition.
2. The minus sign (–) is used for subtraction.
3. The asterisk (*) is used for multiplication.
4. The forward slash (/) is used for division.
5. The percent sign (%) is known as the modulus operator. It is used by some programming codes, such as C++, to return the remainder of an integer division.

Teaching Strategy: *Use VM–A to review equations and to have students practice the order of operations. You may also want to download the poster at http://www.reallygoodstuff.com/pdfs/154513.pdf to hang in the classroom for students to use as a reference. Then have students write equations that implement the order of operations.*

Objective 2: Define terms commonly used in game scoring schemes.

Anticipated Problem: What terms are commonly used in game scoring schemes?

II. Common terms in gaming

A. To ***decrement*** is to take away or to reduce. In a war game, each time a player destroys an enemy tank, the number of enemy tanks the player has to battle is decreased or decremented by one.

B. The term ***health*** is the level of strength or power that the player has available to use in game challenges. For instance, in a boxing game:

1. The player may begin with a high level of health. However, after time goes by and a few punches are taken, health will decrease.
2. If the player is knocked out, health drops to zero.

C. To ***increment*** is to add to or to increase. In a hunting game, the player score is increased each time a game animal is shot.

D. ***Lives*** are the number of chances a player has to accomplish the game objectives.

1. Games commonly allow a player to earn extra lives by reaching a particular score or by successfully accomplishing a difficult challenge.
2. The terms "lives" and "health" sometimes may be interchanged, depending upon the design and terms used in a particular game.
3. Many games depict the number of lives or the level of health with red heart icons.

E. ***Power*** is a term with at least three different meanings in gaming (i.e., health, number of weapons, or advantage).

1. Power can be compared to health because it may indicate the amount of strength the player has available to use in a game challenge.
2. Power may indicate the amount of ammunition or number of weapons a player has available to use in a game.
3. Power may describe an advantage or strength that one player or character has over another (e.g., the ability to fly).

F. ***Score*** is a term that typically takes on two meanings in gaming: points earned and the act of earning points. Scoring (verb) points increases the player's score (noun).

1. Score, used as a noun, is the record kept to indicate the number of points a player has earned in the game.
2. Score, used as a verb, is the act of earning points or accomplishing a task.

Teaching Strategy: *Use VM–B to review the concepts and terms used in keeping score. Have a class discussion so students can share their game experiences with the listed terms. It is helpful to kick off the discussion by giving an example, such as, "When playing Go Fish, I increment my total score by one each time I get a match."*

Objective 3: Write mathematical equations to satisfy scoring requirements for a simple game.

Anticipated Problem: How can someone write mathematical equations to satisfy scoring requirements for a simple game?

III. Mathematical equations in gaming

A. Gaining a clear understanding of how scoring is to take place

1. It is necessary to read the game ***design document***, which is a written item that details every aspect of the game to be created (e.g., game play, characters, and the environment).
   a. This document is used to guide the team creating the game through the development process.
   b. It may be compared to a blueprint for a building.
2. It is essential to simulate the game play. If possible, programmers create a non-electronic version of the game and play it several times to boost understanding of how scoring should work.

B. It is necessary to code equations into the game program by using appropriate arithmetic operators and language syntax.

Teaching Strategy: *Assign LS–A to have students use the order of operations and game scoring terminology to write mathematical equations to meet a game-scoring requirement. For additional practice, students can create their own scoring situations and share them with other students who would write the equations.*

Review/Summary.

Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used in the review/summary.

Application.

Use the included visual masters and lab sheet to apply the information presented in the lesson.

Evaluation.

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. c
2. d

3. e
4. f
5. a
6. b

Part Two: Short Answer

1. The term increment means to add to or to increase. The term decrement means the opposite. It means to take away from or to decrease.
2. The term "power" in gaming may refer to:
   a. A special ability possessed by a character
   b. A character's strength or health
   c. The amount of ammunition or number of weapons a player has available to use in the game

Part Three: Completion

1. addition
2. design document
3. verb
4. noun
5. power
6. parenthesis

Sample Test

Name _____

Apply Basic Math Skills to Create Scoring Schemes in a Simple Game

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. order of operations
b. increment
c. score
d. lives
e. power
f. decrement

_____1. The record kept that indicates the number of points a player has earned in the game

_____2. The number of chances a player has to accomplish the game objectives

_____3. An item that may indicate the amount of ammunition or number of weapons a player has available to use in a game

_____4. To take away; to reduce

_____5. The mathematical rule that states that arithmetic equations are evaluated from left to right in a particular order

_____6. To add; to increase

Part Two: Short Answer

Instructions: **Answer the following.**

1. Briefly explain the difference between the gaming terms “increment” and “decrement.”

2. Describe the three common definitions of power used in gaming.

Part Three: Completion

Instructions: **Provide the word or words to complete the following statements.**

1. In the order of operations, the last step to perform in an equation is _____.
2. A(n) _____ details every aspect of the game being created.
3. The term "score" used as a _____ is to earn points.
4. The term "score" used as a _____ is a record of points earned.
5. An advantage or ability that one player or character has over another is known as _____.
6. Rule 1 in the order of operations states that calculations within _____ must be performed first.

ORDER OF OPERATIONS

The order of operations is a rule that states that mathematical equations must be evaluated from left to right in a particular order.

1. Parenthesis—First, all calculations in parenthesis are performed.
2. Exponents—Second, any exponents are evaluated from left to right.
3. Multiplication and Division—Third, evaluate * and / working left to right.
4. Addition and Subtraction—Last, evaluate + and – working left to right.

REMEMBER: Please **E**xcuse **M**y **D**ear **A**unt **S**ally!

- **P**lease—Parenthesis
- **E**xcuse—Exponents
- **M**y **D**ear—Multiplication * and Division /
- **A**unt **S**ally—Addition + and Subtraction –

Practice: Which solutions are correct and which are incorrect?

- 1.3 * 4 / 2 + 2 = 8
- 2.3 * 4 / (2 + 2) = 3
- 3.2 + 4 / 2 = 3
- 4.2 + 4 / 2 = 4
- 5.12 – 3 / 3 * 2 = 10
- 6.12 – 3 / 3 * 2 = 6

ORDER OF OPERATIONS

- Numbers 1, 2, 4, and 5 are correct.
- Numbers 3 and 6 are incorrect.

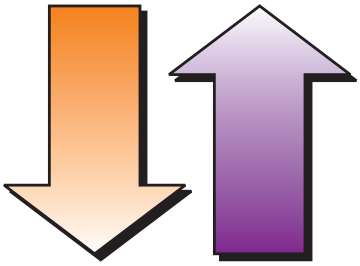
COMMON TERMS IN GAME SCORING SCHEMES

What is the current **score**?

How many **lives** does the player have left?

Which symbol represents an **increment**?

Which symbol represents a **decrement**?



The terms "**lives**" and "**health**" often mean the same thing. Many games depict the number of lives or level of health with red hearts.

What **power** might this superhero have that gives him an advantage over his competitors?

Name _____

Write Equations to Satisfy Scoring Requirements

Purpose

The purpose of this activity is to reinforce scoring concepts in gaming.

Objectives

1. Read the design document and interpret the scoring requirements.
2. Write appropriate equations to meet those requirements.

Materials

- writing utensil
- paper

Procedure

1. Read the scoring scenario below.
2. Beginning with Game 1, read each situation and write a math problem to calculate the score and the lives at that point in the game. In each game, Number 1 assumes the game has just begun; so there are three lives available, and the score is zero.
3. Use the results of situation Number 1 to calculate the score and lives results from situation Number 2 and so on.
4. Determine the number of lives available and the score at the end of each game.

Game scenario:

The objective of this snowboarding game is to snowboard as many mountain ski runs as possible before running out of lives. Each time a run is successfully "boarded," the player earns 1,000 points and moves to a higher run. While snowboarding, the player must attempt to jump several obstacles on the way down each run. The player has three chances to make it down as many mountain runs as possible. If the player runs into a tree, the player loses a life (chance). For every obstacle successfully jumped, the player earns 50 points. If the player attempts to jump an obstacle and falls, the player loses a life. If the player misses a ski lift, the player takes the next lift but loses 50 points. If the player makes it to the bottom of the highest run while maintaining all three lives, the player score is doubled after points are awarded for reaching the bottom. The player starts each game with three lives and a score of zero.

GAME 1:

1. The player successfully jumps an obstacle on the first run.

   Score = 0 + 50 = 50
   Lives = 3

2. The player successfully jumps another obstacle.

   Score =
   Lives =

3. The player attempts to jump an obstacle but falls.

   Score =
   Lives =

4. The player successfully jumps an obstacle.

   Score =
   Lives =

5. The player reaches the bottom of the first run.

   Score =
   Lives =

6. The player successfully jumps an obstacle on the second run.

   Score =
   Lives =

7. The player runs into a tree.

   Score =
   Lives =

8. The player successfully jumps an obstacle.

   Score =
   Lives =

9. The player reaches the bottom of the second run.

   Score =
   Lives =

10. The player misses the ski lift.

    Score =
    Lives =

11. The player successfully jumps four obstacles on the way to the bottom of the third run.

    Score =
    Lives =

12. The player reaches the bottom of the third run.

    Score =
    Lives =

13. The player successfully jumps an obstacle on the fourth run.

    Score =
    Lives =

14. The player runs into a tree.

    Score =
    Lives =

Final score =

Lives =

GAME 2

In this game, the score is updated only when the player reaches the bottom of the run. Write equations accordingly.

1. The player successfully jumps all 10 obstacles on the way to the bottom of the first run.

   Score =
   Lives =

2. The player successfully jumps all 12 obstacles on the way to the bottom of the second run.

   Score =
   Lives =

3. The player successfully jumps only four obstacles but makes it to the bottom of the third run. The player had attempted only five obstacles.

   Score =
   Lives =

4. The player runs into a tree but manages to successfully jump all 20 obstacles on the fourth run.

   Score =
   Lives =

5. The player successfully jumps all 25 obstacles on the way to the bottom of the fifth and final run.

   Score =
   Lives =

Final score =

Lives =

GAME 3

In this game, the score is updated only when the player reaches the bottom of the run. Write equations accordingly.

1. The player successfully jumps all 10 obstacles on the way to the bottom of the first run.

   Score =
   Lives =

2. The player successfully jumps all 12 obstacles on the way to the bottom of the second run.

   Score =
   Lives =

3. The player successfully jumps all 15 obstacles on the way to the bottom of the third run.

   Score =
   Lives =

4. The player successfully jumps all 20 obstacles on the way to the bottom of the fourth run.

   Score =
   Lives =

5. The player successfully jumps all 25 obstacles on the way to the bottom of the fifth and final run.

   Score =
   Lives =

Final score =

Lives =

Write Equations to Satisfy Scoring Requirements

Game 1 Solution:

1. Score = 0 + 50 = 50
   Lives = 3
2. Score = 50 + 50 = 100
   Lives = 3
3. Score = 100
   Lives = 3 – 1 = 2
4. Score = 100 + 50 = 150
   Lives = 2
5. Score = 150 + 1000 = 1,150
   Lives = 2
6. Score = 1,150 + 50 = 1,200
   Lives = 2
7. Score = 1,200
   Lives = 2 – 1 = 1
8. Score = 100 + 50 = 1,250
   Lives = 1
9. Score = 1,250 + 1,000 = 2,250
   Lives = 1
10. Score = 2,250 – 50 = 2,200
    Lives = 1
11. Score = 2,200 + 4 * 50 = 2,400
    Lives = 1
12. Score = 2,400 + 1,000 = 3,400
    Lives = 1
13. Score = 3,400 + 50 = 3,450
    Lives = 1
14. Score = 3,450
    Lives = 1 – 1 = 0

GAME OVER! Final score = 3,450 and Lives = 0

Game 2 Solution:

1. Score = 10 * 50 + 1,000 = 1,500
   Lives = 3
2. Score = 1,500 + (12 * 50) + 1,000 = 3,100 (Parenthesis in this equation do not change the outcome, so they are not necessary. However, sometimes students find them helpful when writing longer equations.)
   Lives = 3
3. Score = 3,100 + 4 * 50 + 1,000 = 4,300
   Lives = 3 – 1 = 2
4. Score = 4,300 + 20 * 50 + 1,000 = 6,300
   Lives = 2 – 1 = 1
5. Score = 6,300 + 25 * 50 + 1,000 = 8,550
   Lives = 1

GAME OVER! Final score = 8,550 and Lives = 1

Game 3 Solution:

1. Score = 10 * 50 + 1,000 = 1,500
   Lives = 3
2. Score = 1,500 + 12 * 50 + 1,000 = 3,100
   Lives = 3
3. Score = 3,100 + 15 * 50 + 1,000 = 4,850
   Lives = 3
4. Score = 4,850 + 20 * 50 + 1,000 = 6,850
   Lives = 3
5. Score = (6,850 + 25 * 50 + 1,000) * 2 = 18,200 (Because no lives are lost throughout the game, the score is doubled after all other points are added.)
   Lives = 3

GAME OVER! Final score = 18,200 and Lives = 3