ZOMBIE APOCALYPSE

GeoJam 2013

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GENERAL OVERVIEW OF THE STATION AND KEY OBJECTIVES

As students walk to our GeoJam station they will be greeted by the Narrator, who is trapped with them in the basement of the school and needs help to protect the safe zones (important rooms such as the Nurse's Office, Woodshop, and Pantry) and a hideout for survival. In the far distance, zombies are waiting to find an entrance to attack. There are three mappings of the school basement with rooms (intersections or circles) and hallways (edges or lines). Each field operative (student) will be assigned to a crate (cardboard box) to block intersections or a zombie repellent (silly string) to block hallways. Zombie Apocalypse is a game that requires students to think about how to strategize a defense plan to block intersections and pathways that is the least costly. This idea originates from a concept in graph theory called *connectivity.* The Narrator will read the intro script and explain the rules of the game. Students have three levels to go through to protect the hideout and safe zones of each level and must work as a team to devise a plan on a blueprint before entering the field. For each level, scoring is based on teamwork and completing each level and its objectives. The rules of the game will be displayed on a posterboard for students to refer to, and the Narrator will provide students with hints if needed.

MATERIALS REQUIRED

- 3 Canvas Drop Cloths
- At Least 3 Large Boxes
- Dark Paint
- Poster Board
- Pictures of Different Rooms
- Silly String
- Paper Cutouts of Zombies, Hideouts, and Safe Zones
- Tape
- Music with spooky sounds or Thriller

COSTUME/PROP IDEAS

- Narrator: The narrator should have survival clothes on. Possible costume - vest.
- Zombies: The zombies should have clothes that look dirty and torn up and have makeup on to make them look like zombies. Possible costume - torn up clothes colored with watercolors, white, red, and green face makeup, dishevelled hair.
- Crates: Painted boxes of various large sizes
- Zombie Repellent: Silly string

INTRODUCTION SCRIPT

Zombies: Walk around behind the map while the narrator is speaking.

Narrator: "Thank goodness you all are here! I thought I was alone, trapped in the basement of Central High School. The zombies are quickly approaching. But it is such a relief to see that I am not the only one! There is only one staircase to the basement and we need to keep the zombies away, after all you don't want to turn into a zombie yourself! It won't be long until the zombies start making their way through the staircase barricade to your hideout - they can smell us from a mile away. You're going to have to use your expert zombie-repelling skills to keep you and your friends safe. But first, there are a few rules to follow that are essential to surviving this zombie apocalypse."
Narrator: "Now, we have a couple different ways to keep the zombies from getting to our hideout. One way is to place a crate on an intersection. These crates can block zombies from going past that intersection from all directions."
(**Narrator** places a crate on an intersection and **zombie** walks into it, showing she can't get past.)
Narrator: "Unfortunately these crates are hard to move and we only have a limited number, so to fend off the zombies, we can also use zombie repellent. However, this can only block one zombie at a time. Luckily our hallways are so narrow that only one zombie can fit in it at a time! Just remember: You can't use zombie repellent in an intersection, because then zombies from all directions can get to you."
(**Narrator** tries to use zombie repellent on an intersection while multiple **zombies** come at her.)
Narrator: "This means we can only send a field operative with zombie repellent to a hallway."
(**Narrator** stands in a hallway with zombie repellent and sprays the **zombie** as it comes down the hall.)
Narrator: Ok, now we've got all we need to secure the hideout. However, we don't want to send field operatives out before we're completely sure of where they are going. So, when the whole group is ready, everyone yells, "Zombie Attack!" and then go out together. Make sure you work on the blueprint I give you and you are working together. If someone does not get to go out in the field this time, they'll be sure to go out next time! If you are able to secure all areas and work as a cohesive team, you'll earn full points for this mission. Now hurry and secure our hideout!"

SUCCESS SCRIPT (If the students' plan works)

Narrator: "Hooray! The zombies are retreating! Quick, everyone, return to the hideout so we can secure the next area!" *Students return to the hideout & the next map is explained & prepared*

FAILURE SCRIPT (If the students' plan doesn't work)

Narrator: "Oh no, they made it through! Retreat, retreat!" *The zombies will vacate the map and the students will get to try again.*

POSTER DESCRIPTIONS

RULES

1. Use: **Crates** to block <u>intersections</u> and **Zombie Repellent** to block <u>hallways</u>

2. Stay off the map until the plan is finalized
3. You may write on a copy of the blueprints
4. When your defense plan is ready, yell “ZOMBIE ATTACK!” all at once
5. WORK TOGETHER

POINTS

Completing Map	1 point
Completing Objective	1 point
Total	6 points
Teamwork	4 points

Examples of good teamwork:

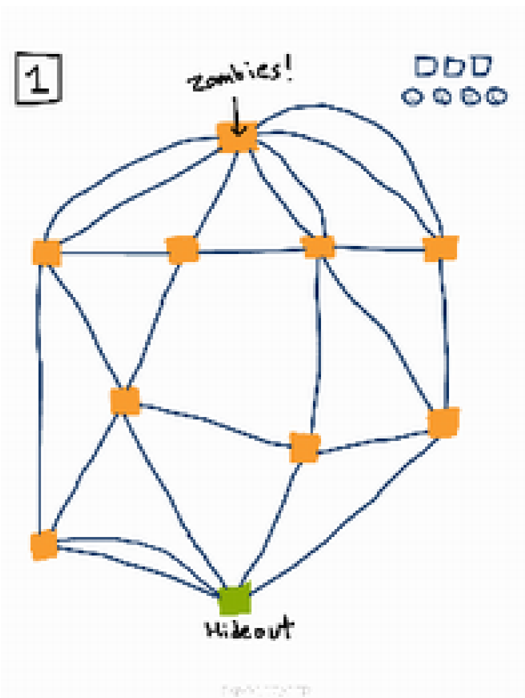
- *Everyone contributes to and agrees on the plan before going onto the map*
- *Everyone yells “Zombie Attack” at once*
- *Everyone goes out onto the map at once*
- *Everyone takes a turn going out onto the map*

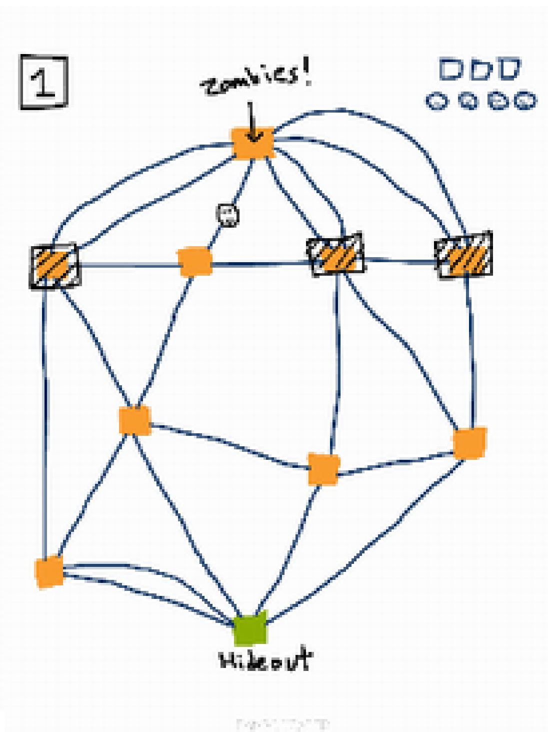
Using a Hint	-1/2 point
Total Possible Points	10 points

DIAGRAMS + SOLUTIONS/INSTRUCTIONS

To set up the maps, lay each tarp down one on top of the other, with level 3 on the bottom, level 2 next, and level 1 on the top. This way, transitioning from one level to the next will go much more smoothly. Keep extra boxes and silly string off to the side; at the transition between each level, place the required number of boxes (squares in the below diagrams) and silly string (one for each person allowed on the level, marked by smiley faces) to the right of the “Hideout” on the map. Hand out one copy of the blueprints (the blank versions of the maps pictured below) to the team at the beginning of the level and provide a pencil for them to use to mark it.

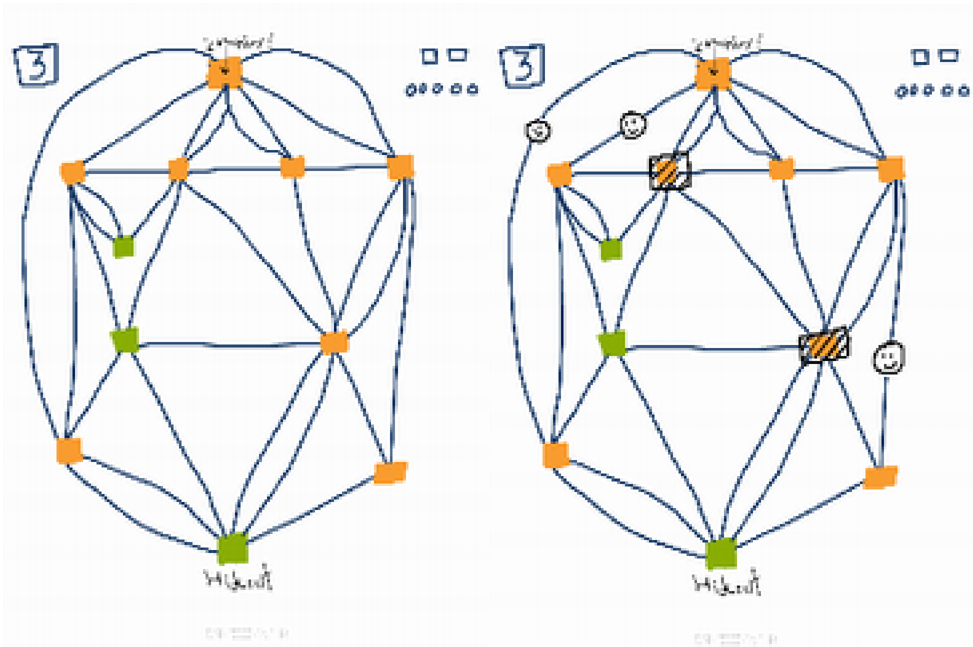
Most of these maps have multiple solutions. Below, the left side shows the map as the students will see it (both on the floor and in the blueprints). The right side shows one *possible* solution to that map. A solution works if there are no possible paths for the zombies to take to get to any of the green safe areas. Note that students are not allowed to place crates / repellent on a green vertex. Possible hints for each level are provided underneath.





Possible Hints for Level 1:
- Consider blocking all entries into the hideout OR
- Consider blocking all paths from the staircase

Possible Hints for Level 2:
- Where do you have no choice but to place a crate? A zombie repellent?
- Use crates efficiently - use zombie repellent first if you can; use crates to block many paths
- What pathways are still not blocked off?



Possible Hints for Level 3: Same hints as in level 2, along with:
- If they place a crate on the top left vertex - suggest zombie repellent in the hallway instead
- Don’t forget, zombies might be able to walk around and get in from “behind” (this can happen if the right side of the map is not properly secured)

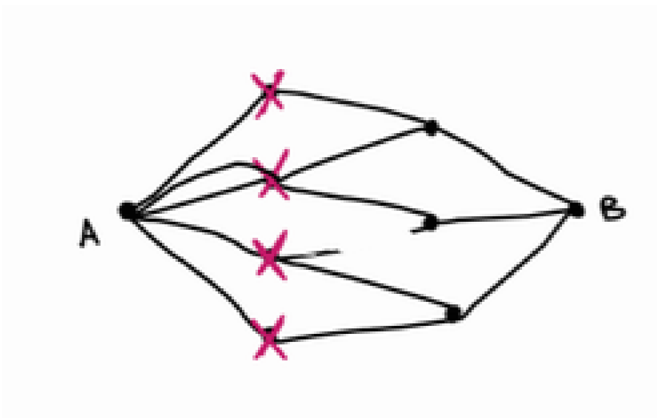
DID YOU KNOW?

In this game, you were working on a problem in Graph Theory - how to delete edges or vertices from a map in order to disconnect two points. These problems are called *connectivity* problems.

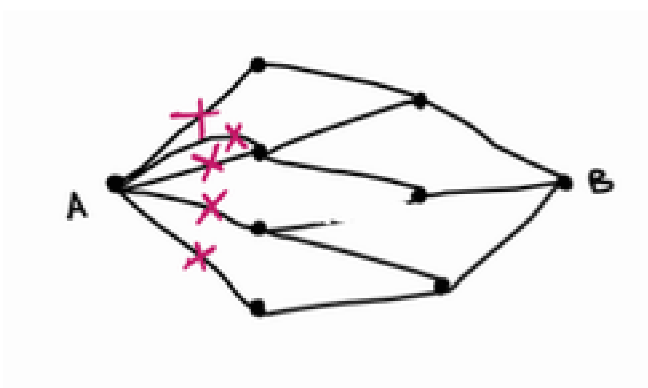
For most graphs, there are lots of ways to disconnect them. In the zombie game, you were disconnecting points by deleting a mix of both edges and vertices. For most connectivity problems, mathematicians only deal with either deleting vertices or deleting edges.

One way to guarantee that two points get disconnected is to delete all of the edges / vertices coming out of a vertex.

For example: In the graph below, you can separate points A and B by either deleting all the vertices connected to A, or all the edges connected to A.



Deleting all **4 vertices** connected to A – now there is no path from A to B!



Deleting all **5 edges** connected to A – now there is no path from A to B!

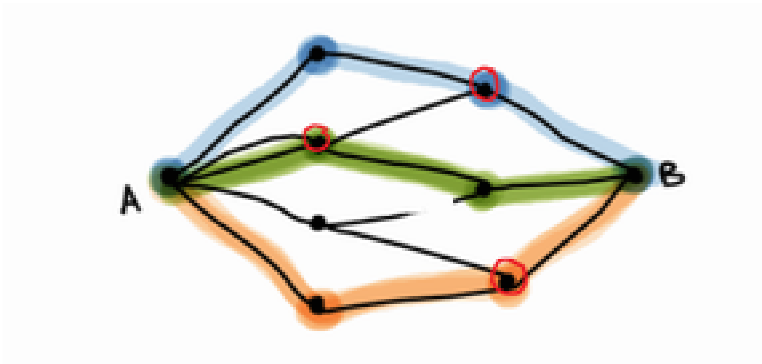
However, this isn't always the "cheapest" way. Maybe there is a way to disconnect A and B by deleting fewer edges or vertices.

For *any map*, the cheapest way to disconnect two points is:

If you're deleting **vertices (edges)**: Trace out the highest number of paths between two points where those paths **do not share any vertices (edges)**. That number of paths is the smallest number of vertices (edges) you will have to delete to separate those two points!

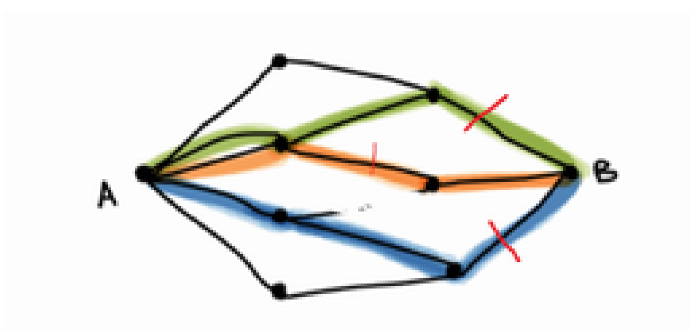
Let's check this on our graph.

If we're deleting vertices, then we try to draw as many paths as possible where the paths **do not** have any common vertices. This means, except for A and B, the paths never cross.



In our graph, we can create a maximum of 3 paths where the vertices inside of them aren't shared. So, if we deleted the 3 circled vertices, we can disconnect A and B. That is better than the 4 vertices we deleted at first!

We check the same thing with edges. In this case, the paths **can** share vertices, but **cannot** share edges.



Here, we found 3 paths that don't share any edges. So, we can delete the 3 marked edges to disconnect our graph, beating the 5 edges we deleted at first!

This theorem is called *Menger's Theorem*, proven in 1927 (for math, that makes it a pretty new idea!) and is one of the most important theorems in Graph Theory!