335 — Algorithm Engineering — Asgwilanga Caverns

Project #2 — Searching the Great Asgwilanga Caverns

Introduction

So, this is a an algorithm visualization task. Specifically, your task is to display the steps (and state of progress) in a search to find a path from an extremal cave room to the "most-central" cave room of the great Asgwilanga Caverns, which consists of a number of cave room subsystems with cave rooms connected by directional causeways (i.e., the causeways allow travel only in one direction, typically by a big jump off a descending section ledge across a fallen gap – for which some blame the grey wizard).

Asgwilanga Caverns

The Asgwilanga Caverns system is made up of different Caves subsystems, each with at most a few dozen cave rooms. In the Caverns, each cave room has a bronze plaque which conveniently gives that room a three-part ID name. Each part is a small positive integer. (The Asgwilangas liked integers.) The cave rooms are connected by causeways that are in bad repair. Nearly every causeway slopes both up and down at spots, and in places it has fallen leaving gaps that allow traversal in only one direction.

The cave ID names have a peculiar properties. Firstly, if the room is closer to the center of the Cavern system, the name's numeric "residue" will be closer to 0. The room's residue is the sum of the absolute values of the differences of the three integer ID name parts of the room. For example, if a room had ID (6, 8, 1) then its residue would be 14 = 2+7+5 = (|6-8|)+(|8-1|)+(|1-6|), and a room with ID (6, 7, 6) would have a residue of 2 = 1+1+0, and a room with ID (6, 7, 9) would have a residue of 6 = 1+2+3. To save display space, for room IDs, you may use hexatrigesimal (base-36) triples, which is closer to the ancient Asgwilangan room names: (6,7,9)=679, (13,17,2)=DH2, (12,10,29)=CAT.

The Causeways

The Asgwilangans built causeways, extending the natural rock fracturing, to connect the cavern into several different cave room subsystems. They distinguished each cave room system by marking all the causeways of that system with the same color. You are going to explore just one of the colored Cavern subsystems. Note, some of the cave rooms have more than one color of causeway leaving them, but you will only take the same color of causeways, exploring just one Caves subsystem.

To understand the causeway coloring scheme, you need to understand that each color has its own room **ID Limit Rule**, which limits the maximum value for each of its three ID parts. For example, the ID Limit Rule for the Puce Caves is 16, 8, and 4. There is, for example, no room ID of (8, 3, 5) in the Puce Caves because in this room ID the third ID part, 5, would be bigger than the third ID limit, 4. (The Puce Caves only connect a few rooms, and hence are rather dull.)

The Asgwilangans built causeways in a way such that the Cavern causeways of a particular color obey several other rules, too: the Sum Rule, the Single-Same Rule, and the Zero-Max Rule.

The **Sum Rule**, states that causeways have the property that the room ID you leave from has the same three part ID sum as the room you arrive at. If you were in room (6, 7, 9), its sum is 22 = 6+7+9. Any causeway leaving this room leads to another room whose ID (A, B, C) has a sum of 22 = A+B+C. (Note that this is independent of the causeway's color. The color governs the ID Limits.)

The **Single-Same Rule** states that the arrival room shares exactly one unchanged ID part with the leaving room; the ID name values of the two rooms differ in exactly two of their ID parts. Which of the three ID parts remains unchanged depends on which causeway you take. For example, if you were in room (6, 8, 2) then you might be able to take a causeway to room (6, 3, 7), which only changed exactly two ID parts -- as long as this obeyed the other rules.

The **Zero-Max Rule** states that of the two changed room ID parts, in the arrival room either one part

is at its limit (it is Maxed out) or is zero. So, if you really did move from room (6, 8, 2) to (6, 3, 7), then we could deduce that the third ID name part must have an ID Limit of 7 since no ID part was zero, the first ID part was unchanged, and the second ID part was reduced. Alternatively, if the colored Caves subsystem you were in had a first part ID Limit Rule of 15, then you could have instead moved from (6, 8, 2) to (14, 0, 2); which leaves the third part, 2, unchanged and all of the second part ID value is zeroed, but the Sum Rule still holds 16 = 6+8+2 = 14+0+2, and so does the Single-Same Rule. But in this example, notice that would be no causeway from cave (14, 0, 2) to (6, 8, 2) unless the Caves subsystem Limit Rule had a second ID part limit of 8. The Asgwilangans were pretty clever.

Visualization Task

You will create a Javascript program that will show (as a graph) the cave subsystem that you explore starting with the given cave room of the given color Caves subsystem (which will include that color's ID Limits. You may use any exploration algorithm that you choose that assumes you don't know about a cave room until the algorithm visits it during the visualization run. Your **visualization should pause** for between 1/5 and 1 second between each new causeway that is explored. (This means you will need to understand how to pause your algorithm in JS.) Each new causeway and the arrival cave room should be displayed as it is traversed and visited. Only one copy of any particular cave room should be displayed in your graph, but you can move it (and its associated causeways) if you wish.

There are fewer than 40 rooms in any single Caves subsystem reachable from the given starting cave room and color in the great Asgwilanga Caverns**.** The particular Caves subsystem and starting cave room **will be given in class**, when we discuss this project.

Complexity Order

As before.

Team

The team may contain up to four members. You may change team members from the previous project.

Project Reporting Data

As before. And please use this naming style: the **date in YYMMDD** format, your **section** (02, 04, or 05), your **3-4 letter team name** (eg, `ABX`): like this "`335-02-p2-ABX-Standup-190212.pdf`", **lest points be taken off.**

Readme File

As before.

Academic Rules

Correctly and properly attribute all third party material and references, if any, lest points be taken.

Submission

As before.

Grading

As before.