

# $\sqrt{CCML}$ Video Contest – Meet 2 2021-2022

## Guidelines

- Students from each half of your team (freshman/sophomore or junior/senior) from your school may submit up to two videos on the given problem. Each video submitted must be produced by different students, but must all be from the appropriate grade band. If your school decides to submit two f/s videos, there should be different students in each video.
- Each video should be no more than SIX minutes in length. Note that this does not mean that you have to fill the entire six minutes.
- The problems are to be solved and the videos produced by student groups. The bulk of the work should be done by students. A parent or teacher holding a camera is fine, but solving a problem for the students is not.
- Videos must be produced by a group of at least two students, and at most five students. Each participating student's contribution should be made evident either from an appearance in the video or a credit at the beginning or end of the video. Indicate names of all students involved (maximum of 5) in credits or introductions at the beginning or end of the video.
- The top f/s video and j/s video from your school will earn points for your overall team score according to the attached rubric.
- Creative solutions and presentations are encouraged, but correct math is paramount. Please make the focus of your video the mathematics. If you have a creative context, great, but it should not be the focus of your video. Soundtracks should not distract or interfere with the explanation of the solution.

## Submission

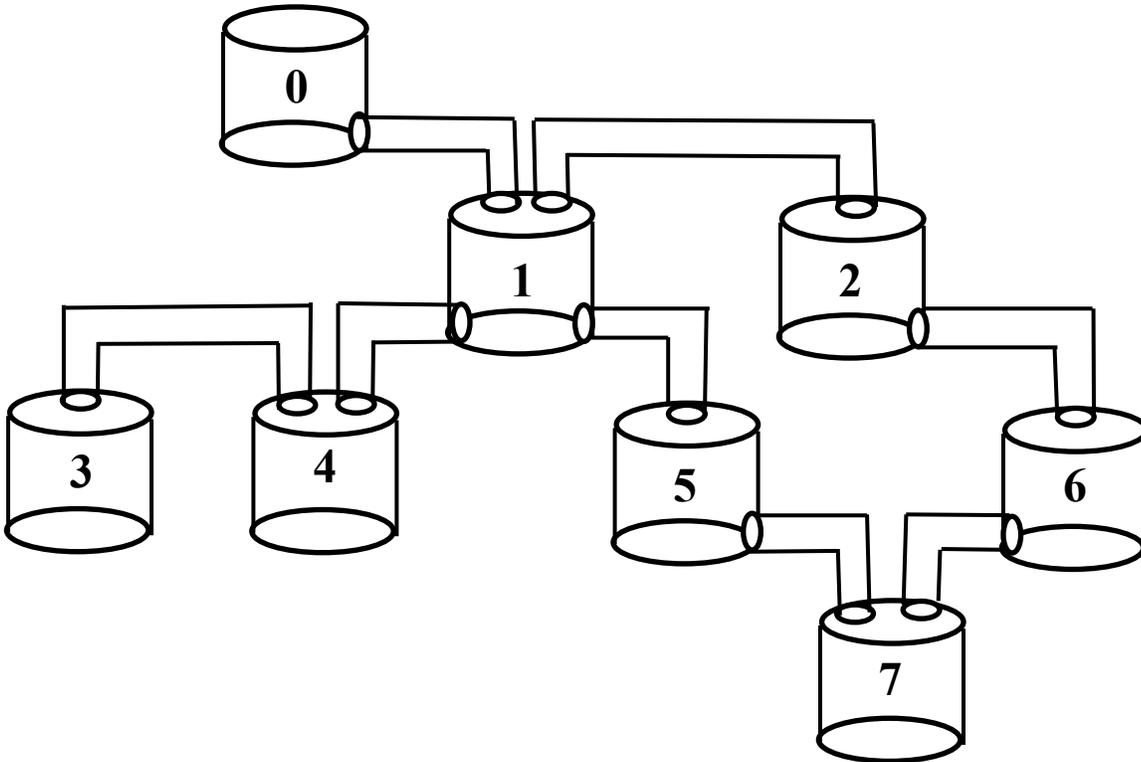
- Coaches should ensure that no more than two videos per grade band are submitted.
- **Make sure that videos are viewable by anyone with the link!**
- Coaches should upload videos to Google drive and share access with Michael Caines (macaines@cps.edu). Please use the following naming conventions for the videos: **school\_level\_teamnumber\_contestnumber\_year**. For example, a submission for CCML 3 for a f/s team from Kelly in the 2015–2016 school year should be named as follows, **kelly\_fs\_team1\_contest3\_1516**. A submission from a j/s team from Lakeview should be named **lakeview\_js\_team1\_contest3\_1516**
- **All submissions must be shared by 5pm on Tuesday, November 9, 2021.**

Please direct any questions about the contest to Michael Caines (macaines@cps.edu). Coaches who are interested in helping judge the submissions should email Michael Caines by the submission deadline.

## Problems:

- **Freshman/Sophomore Problems:**

Below is an arrangement of eight buckets, numbered 0 through 7. Buckets can have pipes connected to their tops or to their bottoms. Water in a bucket will immediately flow into a pipe attached to the bottom of that bucket, while water cannot flow into a pipe at the top of a bucket until that bucket is full. (For the purposes of this problem, assume that the lengths of the pipes are negligible so that pipes do not contribute to travel time of water from bucket to bucket.) All buckets are initially empty.



(a) If water is continuously poured into the top of bucket 0 from an outside source, what is the number of the first bucket to fill completely?

(b) Suppose that water is continuously poured into the top of one of the buckets from an outside source. When one bucket is completely filled, there are  $n$  buckets that are empty or partially filled. Give the minimum and maximum values of  $n$ .

(c) Suppose that we encode the state of the bucket and pipe system with an eight-digit binary number, where bucket 0 corresponds to the units digit, bucket 1 corresponds to the twos digit, bucket 3 corresponds to the fours digit, etc. A digit will be 1 if the bucket is completely filled and 0 if the bucket is not completely filled.

If a seven- or eight-digit binary number is selected at random, what is the probability that it could correspond to an actual state of the system?

- **Junior/Senior Problems:**

- (a) Twelve people are seated around a circular table. Simultaneously, every person moves  $k$  seats clockwise, and they then repeat this process until everyone is in their original seat. Given that  $1 \leq k \leq 12$ , for which values of  $k$  will each person visit every seat?
- (b) If all of the distinguishable permutations of the word EVERETT are listed in alphabetical order, which permutation is 200<sup>th</sup> on the list?
- (c) In a certain game, you roll two fair six-sided dice and one fair four-sided die. You win if exactly one of the dice shows a prime number or if the sum of the dice is prime. What is the probability of a winning roll?

## CCML Video Contest Rubric

Team Name: \_\_\_\_\_ Contest: \_\_\_\_\_ Year: \_\_\_\_\_

<b>Part (a)</b>	<b>0</b>	<b>1</b>		<b>2</b>
	<ul style="list-style-type: none"> <li>No attempt is made, or the work contains profound errors.</li> </ul>	<ul style="list-style-type: none"> <li>Problem contains some good work, but also nontrivial errors.</li> <li>Explanation of work is unclear.</li> </ul>	<ul style="list-style-type: none"> <li>Problem contains only trivial errors or no errors.</li> <li>Explanation of work is clear.</li> </ul>	
<b>Part (b)</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>
	<ul style="list-style-type: none"> <li>No attempt is made, or the work contains profound errors.</li> </ul>	<ul style="list-style-type: none"> <li>Problem contains some good work, but also multiple nontrivial errors.</li> <li>Explanation of work is unclear.</li> </ul>	<ul style="list-style-type: none"> <li>Problem contains no more than one nontrivial error.</li> <li>Explanation of work is generally clear.</li> </ul>	<ul style="list-style-type: none"> <li>Problem contains only trivial errors or no errors.</li> <li>Explanation of work is clear.</li> </ul>
<b>Part (c)</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>
	<ul style="list-style-type: none"> <li>No attempt is made, or the work contains profound errors.</li> </ul>	<ul style="list-style-type: none"> <li>Problem contains some good work, but also multiple nontrivial errors.</li> <li>Explanation of work is unclear.</li> </ul>	<ul style="list-style-type: none"> <li>Problem contains no more than one nontrivial error.</li> <li>Explanation of work is generally clear.</li> </ul>	<ul style="list-style-type: none"> <li>Problem contains only trivial errors or no errors.</li> <li>Explanation of work is clear.</li> </ul>
<b>Presentation</b>	<b>0</b>		<b>1</b>	<b>2</b>
	<ul style="list-style-type: none"> <li>Images are sloppy or out of focus.</li> <li>Audio is difficult to hear.</li> </ul>		<ul style="list-style-type: none"> <li>Audio/video are clear.</li> <li>Presentation is organized well</li> </ul>	<ul style="list-style-type: none"> <li>Presentation is truly creative and engaging.</li> </ul>

Score: \_\_\_\_\_ / 10

Notes: