

# Computer Science Scholarship Puzzle Packet

Please set aside about two hours for working on these problems. Feel free to use a calculator on any problem you wish. But if you do, just make a note. "By Calc," for example.

Some of these problems are quite quick, while others are intended to invite more effort and reflection. Feel free to skip around and spend more or less time on each problem. It is not expected that you will solve all of the problems.

At the end, you are asked to take a little additional time to reflect on your work and the problems.

6. How many two-digit numbers are there, the sum of whose digits is 6?

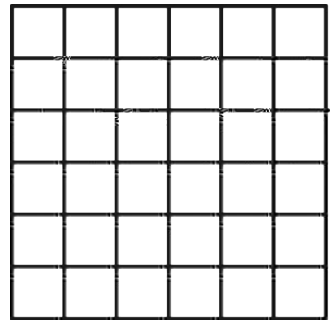
7. What is the smallest value of  $x$  such that  $2^x$  is greater than a billion? How did you solve this?

8. A teacher has a thousand cookies. She gives the first child one cookie, the second child two cookies, the third child three cookies, and so on, until she has given away all of her cookies. How many students got cookies? Explain your thinking.

.. , hen four people all shake hands with each other, e actly si handshakes take place. ' ow many handshakes would take place if ten people all shake hands with each other\*

). /ou#e probably prime(factored numbers before. For e ample, &12& 3 - x - x2x&2. %nd in algebra, you probably learned that  $4a^5 b^6 a^7 b^3 a^5 b^4$ . Factor - )88.

9. %9 9 checkerboard is shown to the right. :ach s"uare can hold one penny. , hat is the largest number of pennies that can be placed on this checkerboard so that no two pennies are adjacent hori;ontally, #ertically, or diagonally\* Please explain your answer.



## Counting Triangles

How many triangles are there in the figure to the right? Note that there is a right way to count these triangles, and a wrong way to count them (one by one).



## Christmas M&Ms

Marah is hosting a party and has purchased two bags of M&Ms. One bag is all red M&Ms, and the other is all green. Each bag has 111 M&Ms. At first she puts them in separate bowls, but then decides that mixing them together might be more festive. So she takes a ladle, scoops 20 M&Ms from the red bowl and puts them into the green bowl. She mixes them around a bit, then scoops 20 M&Ms from the mixed bowl and pours them into the red bowl. When she's done, will there be more red M&Ms in the green bowl, or more green M&Ms in the red bowl? Explain your answer.

## Love Letters with Will

After changing love letters for many years with his beloved, Will is now able to discern her mood just based on the string of A's and ?'s at the end of her letters. He has devised the decoder to the right that helps him.

It works as follows: Starting at the left (most emoji "feeling neutral"), Will steps from emoji to emoji according to the legend below the graphic. For each A he follows the solid arc, and for each ? he follows the dashed arc.

For example, the string "?AA?" would indicate that she is feeling "lovestruck," as that string follows the path:  
neutral → pleased → tired → D → D → C → lovestruck

Similarly, the string "A?A?" would indicate that she is feeling "neutral," while "?A?A" would indicate that she is feeling "tired."

Q: Will?

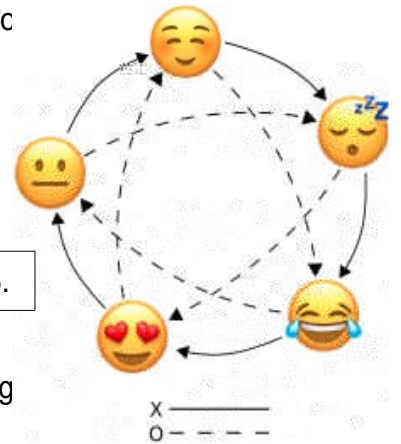
## Love Letters with Tom

Fomls belo#ed has a slightly more regular decodji, as shown to the right. For Fc belo#ed, the string "A ? A ?" would indicate that she is "pleased."

! uppose that Fomls belo#ed sends only A's in her messages. \$n that case, it is easy to characteri;e all messages that indicate that she is feeling "tired" B

She is feeling tired if the string of X's has length two more than a multiple of 5.

Q: \$f her message consists only of ?'s, then what rule characteri;es those string indicate that she is Daughing ? ut Doud\* Explain.



Q: Gi#e a rule that makes it easy to tell if Fomls belo#ed is feeling "lo#estruck" from a mi ed string of A's and ?'s. \$t would be nice if the rule had the same fla#or as the pre#ious two rules.

This question matters:

Please re lect on these pro!lems an" #our work\$ Which "i" #ou particularl# en%o## Which not so much& Woul" #ou en%o# working on pro!lems like this in #our classes&