	WASHINGTON STATE MATHEMATICS COUNCIL 2009 MIDDLE SCHOOL MATH OLYMPIAD Session I: FIFTH GRADE PROBLEM SOLVING	5

Enlarging in the Digital Age

Basic Information
Digital pictures from computers, cell phones, digital cameras, and TVs all depend on pixels that are tiny colored dots.

The Problem: Enlarging a picture.
The picture in figure 1 is a black and white picture with each square representing a pixel. It is shown at a very large scale. Normally you don't notice individual pixels as they are very tiny. **When you enlarge a picture the pixel size doesn't change, instead you use more pixels.** The boxed off section is what you will work with. It is 12 pixels long and 12 pixels wide.
IMPORTANT: A pixel is either all black or all white.

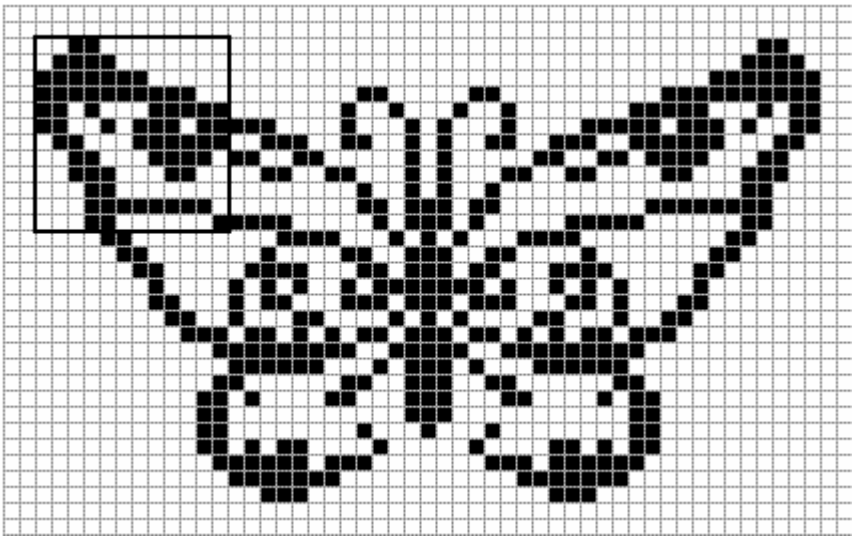

FIGURE 1

Task: Write a set of instructions to enlarge figure 2 by 50% in length and 50% in width.
Figure 2 is a copy of the boxed off section in picture 1. Your job is to come up with a method of how to enlarge the section of the butterfly shown in figure 2 by 50% in the length and 50% in the width (so it should be longer by half as much and wider by half as much). Use your method and the pixel grid paper to create your enlargement. The pixel grid paper provided on the answer sheet uses bigger pixels and a bigger version of figure 2 is also provided.

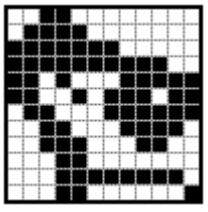

FIGURE 2

Enlarging a picture is an art as well as being mathematical. Writing a really good enlarging program is a tough assignment and you are starting that process with your instructions. Your team will need to make decisions on which squares to black in and which to leave white to get an enlargement that is as accurate as you can make it to the original picture. Write a set of instructions so that another team could follow your instructions and produce close to the same enlargement you made. Except for possible final touch ups your instructions should also work to enlarge the whole butterfly or any other picture. Hint: Consider breaking up figure 2 into smaller sections to enlarge one at a time.

Read these first and answer them as you work:

1. How many pixels are you using in the length and in the width for the final enlargement and why?
2. A 2×2 box in figure 2 will become what size box in your enlargement?
3. If you break figure 2 up in to 2×2 boxes, where do they go and what happens to them under your enlargement?
4. In figure 2 the number of black pixels is about 72 and the total number of pixels is 144. What portion of the picture is made from black pixels? Compute it as a fraction, decimal, or a percent. What portion of the picture is made from white pixels? Compute it as a fraction, decimal or a percent.
5. In your team's enlargement of figure 2 what portion of the picture is made from black pixels and what portion is made from white pixels? You can estimate here if you explain your estimate. How does this compare to your answer in 4; is it more, less or about the same for each color?
6. Review your team's decision making processes for making a pixel black or white and write a set of instructions that includes this decision making process. A set of instructions meets standard if another team can follow them and produce the same or almost the same enlargement you did without making any new decisions not included in your instructions. They should also work for enlarging other pictures except for possibly some final touch ups.
7. Judge the quality of your work: Why do you think your enlargement is as accurate as you can make it? How good are your instructions? Be sure to consider your answers to 1-5 in your explanation and how your final picture looks as compared to figure 2.
8. Turn in all work even if it is still a work in progress.

Your enlargement together with complete responses to questions 1 - 7 are sufficient evidence for the judges to work with.

<u>Your work will be evaluated on</u>:

- Your Problem Solution.
- Your Understanding of the Problem.
- Your Strategies Used.
- Your Communication.
- Your Reasonableness/Reasoning.