



## Answers to the test

20 June 2010

On 5 June 2010, I had asked you to answer a few questions concerning the basic terminology of programming and programming languages. We have talked in class about the more or less correct answers. Here they are, once more, in writing.

**Question 1:** What are the components of a variable?

A variable is a quadruple of (name, type, value, location). Instead of location you often find “reference” (to the location where the variable’s value is stored).

**Question 2:** What is the difference between a variable and a constant?

A constant is a variable whose value is not allowed to change.

**Question 3:** What is a coordinate system good for?

A coordinate system allows for a unique identification of the points in a given space. The identification works both ways: given a point in the space, we can uniquely determine its coordinates. But, given the coordinates, we can uniquely determine the point in space corresponding to the coordinates. – The minimal number of coordinates of the coordinate system needed to describe the points, is the dimension of the space.

**Question 4:** How is Processing’s coordinate system defined (axes, orientation, measures)?

Origin of the two axes is in the upper left corner. The positive x-axis extends to the right, the positive y-axis extends downwards. This is a left-handed system. The unit length along each of the two axes is 1 pixel.

**Question 5:** What is a type? What distinguishes the two types, float and int?

A type is a set of elements of “the same kind” together with a set of operations allowed on individuals, pairs, triples, etc. of elements. Mathematically speaking, a type is an algebra.

Both, float and int, are numeric types. int is a finite subset of the set of integer numbers. float is a finite subset of the set of rational numbers. Its elements can be represented by finite decimal fractions. We recognize values of type int by not having a decimal point, whereas values of type float have a decimal point.

**Question 6:** What are the rules for executing a sketch containing a setup and a draw function?

In Processing, the fundamental structure of a program (“sketch”) consists at least of the definition of a `setup()`-function, and a `draw()`-function. The setup function is executed exactly once. It defines values in the environment of the program (sets values of certain state variables).

The draw function is repeatedly and continuously executed at a defined frequency. The default value of this framerate is 30, which the processor tries to achieve.

**Question 7:** Write (on paper) a short program (a sketch) that creates a horizontal line of 20 squares. Each square is of size 10 x 10 pixels and has a random color.

One solution could be

```
size(400, 400);
background(0);
int x = x0; int y = y0; // x0, y0 are the coordinates of the upper left vertex of the strip
int s = 10; // s is the size of the squares
int n = 20; // n is number of squares in the strip

for (int i = 1; i <= n; i++)
{
  int r = int(random(0, 255)); // red component, chosen randomly over full range
  int g = int(random(0, 255)); // green component
  int b = int(random(0, 255)); // blue component
  fill(r, g, b);
  rect(x, y, s, s);
  x = x + s;
}
```

Here is a very brief comment on your answers. In general, most of them show a satisfactory basic understanding of these terms. None of the answers is precise in language (the variable, the type, the coordinate questions, e.g.). This will be okay for virtually all situations when you program: the skill level. For a discourse on programming or algorithms, it would not be enough. Algorithmic thinking requires utmost precision. You must try to improve this capacity.