Queen Mary
University of London

Variable Dry Run (for Scratch)

Age group:	7 – adult
Abilities assumed:	Very simple programming, basic understanding of assignment and variables
Time:	20-50 minutes depending on student experience
Size of group:	unlimited

Focus

Variables
Assignment
Sequencing
Programming

Syllabus Links

This activity is appropriate for any syllabus aim about learning to program at any level that requires an understanding of variables and assignment.

Summary

Set a series of dry run exercises where students have to *step through short fragments of code working out what they do on paper.* This is an important activity to do after explaining variables and assignment. It reinforces understanding and helps identify faulty mental models so they can be fixed. Being able to do this kind of dry run for any new construct is an important prerequisite to being able to actually write code.

Technical Terms

Assignment, Variable, Value, Sequencing.

Materials

Dry run exercise sheets

What to do

The Grab:
Use the Box Variable activity as the grad to this one, giving students an understanding of variables and assignment that this activity reinforces.

The activity:

Have the class dry run the given series of short programs on paper (see the exercise sheets provided at the end).

Use these to determine what each student understands. As each finishes the sheet, mark them on the spot, and fix any problems. It is vital that any incorrect mental model is corrected straight away. Common misunderstandings to look out for include:

- that a variable still holds its original value after an assignment,
- that assignment works by copying left to right,
- that a sequence of assignments all happen together
- that a sequence of assignments can happen in any order
- that both left hand side and right hand side change
- that it is like a mathematical equality just making both sides the same so that future changes to one change the other
- that a variable can hold all the values ever assigned to it

If students get any wrong, find out what they have misunderstood, if it is not a lack of care over detail, and explain the correct mental model and their misunderstanding to them. This can be done by stepping through one of the exercises with them.

Have them redo the sheet once they are happy they do now understand.

Variations and Extensions

Student written programs

Have students write their own simple programs using assignment and then dry run them.

Dry Run Tables

Do similar exercises but now using a more compact table format to record the dry run, with one column per variable, crossing out values and moving to the next row as they are replaced.

Further Reading

Computing without computers

A free booklet by Paul Curzon on programming, data structures and algorithms explained using links to everyday concepts. Available from http://teachinglondoncomputing.org/resources/

Links to other activities

Box Variables

Execute run simple programs that involve variables and assignment by running them on a computer made of students.

Students with boxes act as variables as values are copied between them following the instructions of a program. You physically demonstrate the creation of variables, how accessing a variable involves taking a copy of its value, and how storing values in a variable destroys any previous value stored.

The swap puzzle

Solve a puzzle, coming up with an algorithm that your team can follow faster than anyone else.

This gives a way to introduce the idea of the solution to a problem being a set of instructions that allow others to 'solve' it with no understanding. It also explores how different algorithms can solve the same problem but may not be equally good – some may be faster.

The intelligent piece of paper

Take part in a test of intelligence against an intelligent piece of paper!

This is a good introduction to what an algorithms is and how a computer program is just an algorithm. It can also be used to start a discussion on what it would mean for a computer to be intelligent. It can lead on to an unplugged programming activity creating winning instructions.

The Invisible Palming Trick

Teach a trick where the magician invisibly moves a card between 2 piles.

This is a fun way to introduce the idea of an algorithm, showing how algorithms are a series of steps that if followed precisely lead to something (in this case magical) being guaranteed to happen – even if the person (or computer) following the algorithm doesn't know what they are doing.

Live demonstration of this activity

Teaching London Computing give live sessions for teachers demonstrating this and our other activities. See http://teachinglondoncomputing.org/ for details. Videos of some activities are also available or in preparation.

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Dry Run Exercises (Scratch)

1. What are the final values stored in x and y after the following code fragment has executed?

```
set x to 5
set y to 7
set x to y
```

The final value of x is _____ The final value of y is _____

Solve this by doing a dry run, filling in the value in the boxes

After

```
set x to 5
```

has executed the variables hold the following values:

x

After

```
set y to 7
```

has executed the variables hold the following values:

x

y

After

```
set x to y
```

has executed the variables hold the following values:

x

y

2. What are the final values stored in x and y after the following code fragment has executed?

```
set x to 5
set y to 7
set y to x
```

The final value of x is _____ The final value of y is _____

Solve this by doing a dry run, filling in the value in the boxes

After

```
set x to 5
```

has executed the variables hold the following values:

x

After

```
set y to 7
```

has executed the variables hold the following values:

x

y

After

```
set y to x
```

has executed the variables hold the following values:

x

y

3. What are the final values stored in x and y after the following code fragment has executed?

```
set y to 7
set x to 5
set y to x
```

The final value of x is _____ The final value of y is _____

Solve this by doing a dry run, filling in the value in the boxes

After

```
set y to 7
```

has executed the variables hold the following values:

y

After

```
set x to 5
```

has executed the variables hold the following values:

x

y

After

```
set y to x
```

has executed the variables hold the following values:

x

y

4. What are the final values stored in red and blue after the following code fragment has executed?

```
set red to "red"
set blue to "yellow"
set red to blue
```

The final value of red is _____ The final value of blue is _____

Solve this by doing a dry run, filling in the value in the boxes

After `set red to "red"` **has executed the variables hold the values:**

red

After `set blue to "yellow"` **has executed the variables hold the following values:**

red

blue

After `set red to blue` **has executed the variables hold the following values:**

red

blue

5. What are the final values stored in x and y after the following code fragment has executed?

```
set y to 7
set x to 5
set y to x
set x to 3
```

The final value of x is _____ The final value of y is _____

Solve this by doing a dry run, filling in the value in the boxes

After

```
set y to 7
```

has executed the variables hold the following values:

y

After

```
set x to 5
```

has executed the variables hold the following values:

x

y

After

```
set y to x
```

has executed the variables hold the following values:

x

y

After

```
set x to 3
```

has executed the variables hold the following values:

x

y

6. What are the final values in x, y and z after the following code fragment has executed?

```
set x to 1
set y to 2
set z to 3
set y to x
set x to y
```

The final value of x is ___ The final value of y is ___ The final value of z is ___

Solve this by doing a dry run, filling in the value in the boxes

After `set x to 1` **has executed the variables hold the following values:**

x

After `set y to 2` **has executed the variables hold the following values:**

x y

After `set z to 3` **has executed the variables hold the following values:**

x y z

After `set y to x` **has executed the variables hold the following values:**

x y z

After `set x to y` **has executed the variables hold the following values:**

x y z

7. What are the final values in one, two and three after the following code fragment has executed?

```
set one to 1
set two to 3
set three to 2
set one to two
set two to three
```

The final value of one is ___
The final value of two is ___
The final value of three is ___

Solve this by doing a dry run, filling in the value in the boxes

After `set one to 1` **has executed the variables hold the following values:**

one

After `set two to 3` **has executed the variables hold the following values:**

one

two

After `set three to 2` **has executed the variables hold the following values:**

one

two

three

After `set one to two` **has executed the variables hold the following values:**

one

two

three

After `set two to three` **has executed the variables hold the following values:**

one

two

three

8. What are the final values in a, b and c after the following has executed?

```
set a to 9
set b to 7
set c to 8
set a to c
set b to a
set c to b
```

The final value of a is ___ The final value of b is ___ The final value of c is ___
Solve this by doing a dry run, filling in the value in the boxes

After `set a to 9` **has executed the variables hold the following values:**

a

After `set b to 7` **has executed the variables hold the following values:**

a

b

After `set c to 8` **has executed the variables hold the following values:**

a

b

c

After `set a to c` **has executed the variables hold the following values:**

a

b

c

After `set b to a` **has executed the variables hold the following values:**

a

b

c

After `set c to b` **has executed the variables hold the following values:**

a

b

c

9. What are the final values in a, b and c after the following has executed?

```
set a to 1
set b to 2
set c to 3
set c to b
set c to a
set a to b
```

The final value of a is ___ The final value of b is ___ The final value of c is ___
Solve this by doing a dry run, filling in the value in the boxes

After `set a to 1` **has executed the variables hold the following values:**

a

After `set b to 2` **has executed the variables hold the following values:**

a

b

After `set c to 3` **has executed the variables hold the following values:**

a

b

c

After `set c to b` **has executed the variables hold the following values:**

a

b

c

After `set c to a` **has executed the variables hold the following values:**

a

b

c

After `set a to b` **has executed the variables hold the following values:**

a

b

c

10. What are the final values in x, y and z after the following has executed?

```
set x to 3
set y to 2
set z to 3
set z to y
set y to x
set x to z
```

The final value of x is ___ The final value of y is ___ The final value of z is ___

Solve this by doing a dry run, filling in the value in the boxes

After `set x to 3` **has executed the variables hold the following values:**

x

After `set y to 2` **has executed the variables hold the following values:**

x y

After `set z to 3` **has executed the variables hold the following values:**

x y z

After `set z to y` **has executed the variables hold the following values:**

x y z

After `set y to x` **has executed the variables hold the following values:**

x y z

After `set x to z` **has executed the variables hold the following values:**

x y z

Answers

1.
The final value of x is: 7
The final value of y is: 7

2.
The final value of x is: 5
The final value of y is: 5

3.
The final value of x is: 5
The final value of y is: 5

4.
The final value of red is: “yellow”
The final value of blue is: “yellow”

5.
The final value of x is: 3
The final value of y is: 5

6.
The final value of x is: 1
The final value of y is: 1
The final value of z is: 3

7.
The final value of one is: 3
The final value of two is: 2
The final value of three is: 2

8.
The final value of a is: 8
The final value of b is: 8
The final value of c is: 8

9.
The final value of a is: 2
The final value of b is: 2
The final value of c is: 1

10.
The final value of x is: 2
The final value of y is: 3
The final value of z is: 2