# ONLINE TESTS FOR LARGE MODULES

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Faculty Assessment Day

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Slides available to download from:
http://computing.coventry.ac.uk/~mengland/Conferences/CUAssessmentDay2017.pdf

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2. A GOOD QUESTION
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# 1. INTRODUCTION

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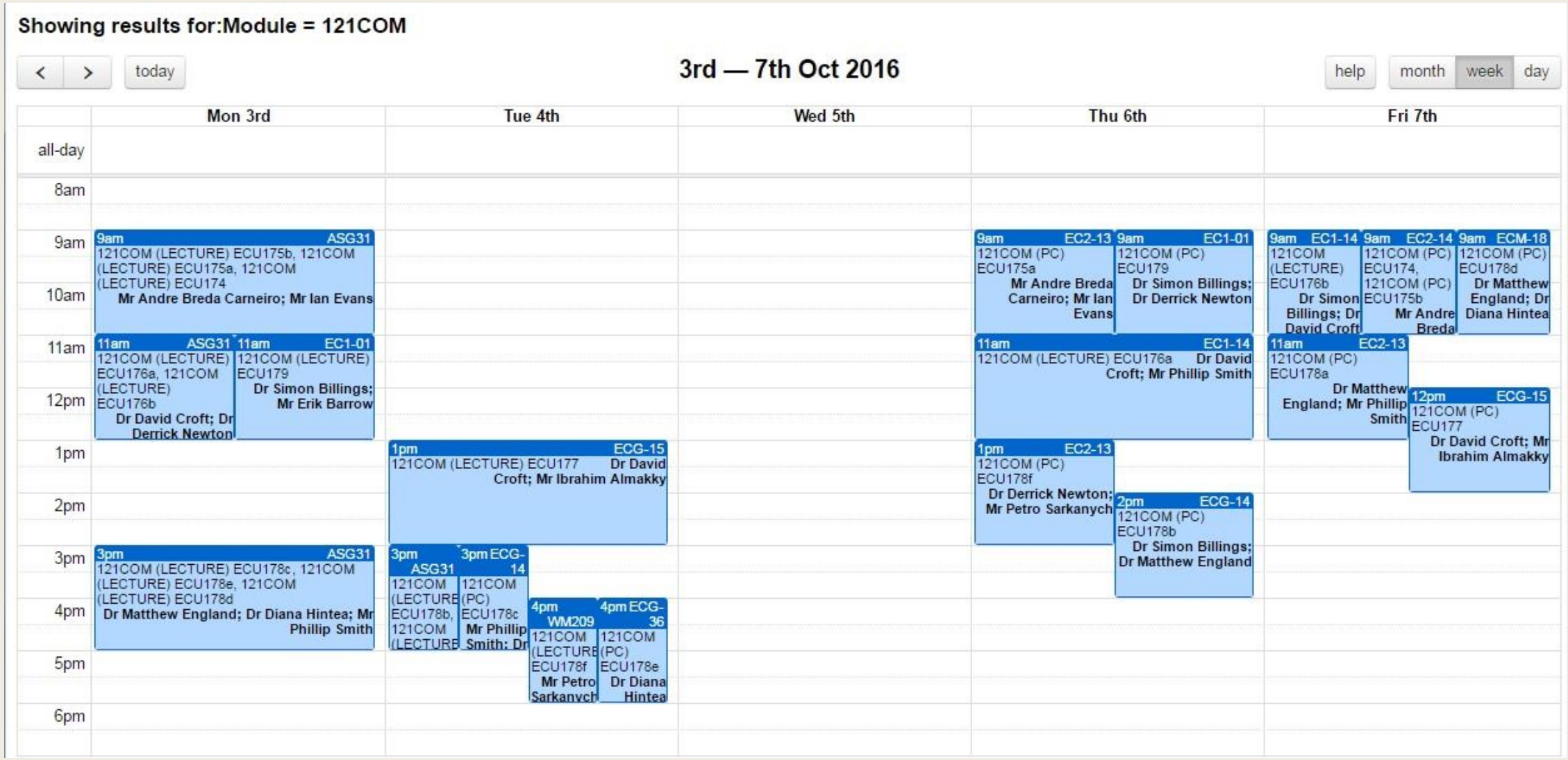
# 121COM and 122COM

- Stage 1 Programming modules:
  - *121COM: Python in Semester 1*
  - *122COM: C++ in Semester 2.*
- Taken by 466 students in academic year 16/17. Any student on:
  - *BSc Computer Science*
  - *BSc Computing*
  - *BSc Business Information Technology*
  - *BSc Games Technology*
  - *BSc Multimedia Computing*
  - *BSc Ethical Hacking and Network Security.*
- Entirely lab based:
  - *121COM had 19 labs each week in academic year 16/17*

# Large Module



# Various Assessments

- Coursework Project:
  - *In Groups of 5-7*
  - *Different brief depending on course*
  - *Run by course teams*
- Written Exam (121COM only)
- Two **Phase Tests** each semester.

The latter is the topic of this talk.

# What do we mean by **Phase Test**?

I know **Phase Test** means different things to different people at Coventry. For this workshop **Phase Test** means:

- Summative Assessment.
- Online Moodle Quiz.
- Automatically marked.
- Taken individually.
- Taken in class under exam conditions.
- (mostly) Multiple choice questions.

# Does this type of assessment make sense for teaching programming?

- Phase Tests one of a variety of summative assessments used.
- Both modules have ILOs to assess other than raw programming.
- Can also ask code based questions:
  - *What would this code do / print?*
  - *What is the error in this code?*
  - *What is the missing line of code?*
  - *Etc.*

# Q) What tools do we use for the tests?

- Simply Moodle quizzes:
  - *But with various Moodle options to ensure test integrity;*
  - *But with extra software to aid invigilation;*
  - *But with some homemade tools to avoid endless button clicking in Moodle.*

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# Fallacy: Multiple Choice Questions are easy

- Not if the alternative answers are (while wrong) **plausible.**
  - *121COM Phase Test 1 Average Mark: 57%*
  - *121COM Phase Test 1 Average Mark: 60%*
  - *14% of students failed a 121COM Phase Test. They are not the "easy component". If anything too hard!*
- You need 8/20 or more questions right to pass a 121COM Phase Test. With 4 possible answers a question the chance of passing by random guess alone is 10.18%.
- But, Multiple Choice Questions are also not easy to write!
  - *4 times harder because you need to think up the right answer plus 3 plausible wrong ones!*

# Example Q1

Q) A **Compiler** _____

a) Converts source code to object code, ready for running on the processor

b) Optimises and tidies up code before running it

c) Interprets source code on the processor line by line

d) Checks source code for runtime errors

# Example Q1

Q) A **Compiler** _____

a) Converts source code to object code, ready for running on the processor

b) Optimises and tidies up code before running it

c) Interprets source code on the processor line by line

d) Checks source code for runtime errors

The only correct answer is the first one. But students will have run into tools that do the other three for them. They are plausible. A passing knowledge of the module material is not enough to find the right answer here.

# Example Q2

In the following Python code which value of n prints the most greetings?

```
if n=='a':
    for i in range(30):
        for j in range(20):
            print('Hello')
if n=='b':
    for i in range(300):
        print('Hello')
```

a) 'a‘

b) 'b‘

c) 'a' and 'b' give the same

d) It is impossible to say without running the code

# Example Q2

In the following Python code which value of n prints the most greetings?

```
if n=='a':
    for i in range(30):
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    for i in range(300):
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```

a) 'a‘

b) 'b‘

c) 'a' and 'b' give the same

d) It is impossible to say without running the code

If you understand what it means to nest loops then it is clear that the answer is (a).

There were practice questions with different numbers: one where the answer was the single loop and one where they gave the same. So (b) and (c) are plausible for students who are just guessing without understanding.

This questions isn’t perfect though because (d) is not really plausible (although that didn’t stop some students choosing it!)

# Writing a good Phase Test question

- Identify a single piece of knowledge to assess for each question;
- Make sure the question is crystal clear.  E.g. in a programming question:
  - *What does this code do?*
  - *What does this code output?*
  - *What does this code print?*
  - *What does this code return?*
- The wrong answers:
  - *Should still be plausible for a student who hasn't studied*
  - *But not aim to "trick" the hard working students (they will complain).*

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# Test Integrity in the room

We enforce exam conditions. However, our teaching rooms are arranged so that students can easily see the computer next to them, or even on other tables. How to avoid cheating?

There are a few low effort options:

- Moodle quiz option to randomize order of questions;
- Moodle quiz option to randomise order of possible answers;

These should certainly be used. But even then there is a good chance of a student seeing a colleague's answer to a question. The default option is to allow students to revisit questions and answers so they could always change after seeing what there colleague put.

# Solution: Categorised Question Banks

You need to use a **Question Bank**: so each student receives a different set of questions.

However, this raises questions of fairness (do students get questions of equal difficulty?) and topic assessment (do all students get tested on same things). Our solution is a **Categorised Question Bank**.

Each 121COM Phase Test has 20 questions so my question bank has 40 categories, one for each question (actually more as I also have a practice question category). In each category I have 4-10 (similar but different) questions that all assess the same specific piece of knowledge. Each student gets one question from each category.

# Example Question Category 1

I have a category of questions to see if students understand basic logic operators. Students will get one of the following:

What is printed by the following Python code?

```
x = not(True or False)
print(x)
```

What is printed by the following Python code?

```
x = not(True and False)
print(x)
```

What is printed by the following Python code?

```
x = False or not(False)
print(x)
```

What is printed by the following Python code?

```
x = True and not(True)
print(x)
```

The possible answers are all:

(a) `True` (b) `False` (c) `x` (d) `Error`

# Example Question Category 2

I have a category of questions to see if students understand floor division (// in Python). Students will get one of the following (actually more than two):

What is printed by the following Python code?

```
a = 10
b = a // 3
print( b )

a) 3.3333333333
b) b
c) 3
d) 1
```

What is printed by the following Python code?

```
a = 13
b = a // 5
print( b )

a) 2.6
b) b
c) 2
d) 3
```

In each case the correct answer is (c) while (a) is the decimal division and (d) is the remainder after division (which is % in Python – studied the same week).

# Test Integrity across cohorts

- In 121COM and 122COM the Phase Tests take place in-labs and thus not at the same time or even the same day. The best we can guarantee is same week!
- How to maintain Test Integrity then?
  - *Ask students not to discuss test – not good enough!*
  - *Large Question Bank: hearing what questions your friend got will not help. Hearing the topics might – but they weren't a secret anyway.*
  - ***Essential: Do not let students see their questions and answers until everyone has taken the test!***
    *This is hidden under "Review Options" in Quiz Setup.*
  - *Scrap paper handed in at end of the test.*

# Other Issues of Test Security

- Set a Test Password so:
  - *Students cannot take the test by accessing Moodle from elsewhere.*
  - *So everyone starts and ends together.*
- But then you must remember to change the Password after every test sitting!
- What if a student texts the password to a friend?
  a) *No phones – exam conditions.*
  b) *Under Quiz Setup – Extra Restrictions set the IP address to 194.66.32 (which means it can only be taken on campus at least).*
  c) *Change password as soon as quiz starts rather than at end of session (this doesn't affect people taking the test).*

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# Invigilation

Q) How to stop students Googling the answer during the test?

A) The **Safe Exam Browser**:

- Available on every university PC via MyLaunch Software Portal.
- Restricts the computer to a full screen browser with CUMoodle.
- It would take 5 minutes to shutdown and reopen.

Warnings:

- Factor in at least 10-15min for getting everyone setup on it! We made a video explaining how: https://www.youtube.com/watch?v=V3U5k-SEJvU
- It can crash (occasionally) – but Moodle saves test answers so far.
- Students can look at material on Moodle easily (and EH students figured out how to break out of it). So an aid but no substitution for good invigilation!

# Practice Tests

- Students should have access to a Practice Test to get them familiar with the test environment, the level of difficulty and the topics you want them to revise.
- The practice test questions should be different to those in the main test:
  - *Especially important if using a Question Bank.*
  - *If one students receives a question seen before and another not that isn't fair.*
- I produce a practice test of different questions – but no need for a bank here. So "just" an extra 20 questions.

# Test length and number of questions?

- There is a **Faculty Assessment Tariff** which you could use to scale to the weighting of your test.
- In Stage 1 Computing modules we use 20 questions in 35 minutes.
- Then need a duplicate test with 44 minutes for extra time students.
- In my experience most students finish within 20 minutes:
  - *Sometimes I let finished students leave early. In that case ensure password is changed before the first one leaves.*
  - *In a big lab or one with a noisy door it can be distracting to those still working. I then force them to stay. I usually place a piece of allowed reading on Moodle that would keep them busy but not be an aid to others taking the test.*
  - *For me, this is the most difficult issue of Phase Tests. Every ACO incident I referred last year was from talented students who finished early, got bored and started chatting.*

# Do you really enter 100s of questions into Moodle?!

Actually, No.

- Thinking up 100s of questions is hard work but necessary.
- Entering them into Moodle by hand is not.
- The Moodle question creation wizard takes a lot of clicking (and waiting for Moodle) per question. Instead:
  - *Create one questions in the wizard;*
  - *Export to XML file;*
  - *Copy and Paste and make the small changes in the XML;*
  - *Then upload the enlarged XML file back to Moodle.*

# My XML file for 121COM Phase Test 1 is about 1000 lines of XML like this

File Edit Selection Find View Goto Tools Project Preferences Help

PhaseTest1.xml

```
821   <question type="category">
822     <category>
823       <text>$course$/Scripted_questions/PT1 - Level</text>
824     </category>
825   </question>
826   <question type="cloze">
827     <name>
828       <text>PT1 - Level - variation 1</text>
829     </name>
830     <questiontext format="html">
831       <text><![CDATA[<p>Python is an example of _____</p><p><br></p><p>{1:MCV:=A high
          level programming language~A low level programming language~A programming
          paradigm~An Integrated Development Environment (IDE)}</p><p><br></p>]]></text>
832     </questiontext>
833   </question>
```

.* Aa “ ” Find Find Prev Find All

Line 824, Column 16 Spaces: 2 XML

# Do you really work in XML?!

Actually, No.

- For multiple choice questions at least we:
  - *Edit questions in a JSON format (familiar to those who use APIs or Python dictionaries. Not hard to pick up).*
  - *Then we run a Python script that converts this to XML. Available on GitHUb here: https://github.com/dscroft/moodle_questions*
  - *Upload the XML to Moodle.*
  - *The script can also further multiple the number of questions but picking 3 from a greater set of wrong answers*
- The script is the work of Dr David Croft (ac0745@coventry.ac.uk).

# So I have to learn Python to take advantage of your tools?

Actually, No.

Dr David Croft has created an executable for Windows machines which does it all for you – you just select the file names of the input json and output xml files.  You just select the file names.

- To access this ask David nicely:
  ac0745@coventry.ac.uk
  or room EC3-11
  or that guy over there.

My json file for 121COM Phase Test 1 is about 1000 lines like this:

File Edit Selection Find View Goto Tools Project Preferences Help

PhaseTest1.json

```
10          "PT1 - Level":
11          [
12              {
13              "type": "choice",
14              "question": "Python is an example of _____",
15              "options": ["A high level programming language",
16                          "A low level programming language",
17                          "A programming paradigm",
18                          "An Application Programming Interface (API)",
19                          "An Integrated Development Environment (IDE)"]
20              },
21              {
22              "type": "choice",
23              "question": "Which of the following is not an advantage of high level program
24              "options": ["They are more efficient in terms of computation time",
25                          "They take less time to write code in",
26                          "They are easier to debug",
```

Line 1, Column 1 Tab Size: 4 JSON

# How to do moderation with this?

- We internally moderate by reading each others  json files.
  - *Check English and question clarity.*
  - *Check right answers are really right (and wrong answers are really wrong)!*
  - *Check wrong answers are plausible (at least some of them).*
  - *Check questions in same category are on same topic and similar difficulty.*
  - *Plus all the usual checks (assesses ILOs, appropriate difficulty etc).*
- The question moderation is a lot more work - but the marking moderation is a lot less!
- You need your moderators fully briefed and on board.
- E.g. also upload a guide explaining the structure of the json file etc. for any external to read.

# Exciting new development!

**CodeRunner** has recently become an official Moodle plugin. Should allow for actual coding in Phase Tests!

- Creates a new Moodle question type that can be combined with others into normal quizzes.
- Students type in code (most major languages supported).
- Code is sent to a separate Linux server, run again teachers test code, and mark sent back to the Moodle server.
- Options to allow set number of runs; syntax checks etc.

We aiming to have a small group trial in 2017/18 and if successfully open up for all 2018/19.

http://coderunner.org.nz/

# The End

- Hope this was helpful.
- Feel free to contact us about this later:

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- Slides available to download from: http://computing.coventry.ac.uk/~mengland/Conferences/CUAssessmentDay2017.pdf
- Any questions?
- I can spend the rest of the time helping you in Moodle.